MODERN PLASTICS

mp

JANUARY 1943

HAROLD VAN DOREN
Industrial Designer

A truck gets its "wings"

That shorter route to India which Columbus sought is making news again. Only this time it includes India . . . *and* . . . all points east and west.

Columbus' America is ready right now to begin building super cargo-planes. Here, at the request of Durez Plastics, Donald Dailey of Harold Van Doren and Associates releases his visualization of such a freight-plane . . .

"In working up this design, we have incorporated into the belly of the plane two truck-trailers such as you see on the road every day. These units would be interchangeable to permit freight to be loaded or unloaded at warehouses, hauled to airports, and picked up by planes to be delivered at other national or international points without the waste involved in frequent rehandling of the merchandise itself.

"To get these trailers *light* enough for flying purposes yet *strong* enough for freight service, they would be constructed of Durez resin-bonded plywood. Those Durez resins, you know, glue thin wood veneers together into plywood, bonding them with such strength that, pound for pound, they are stronger than metal. Further, Durez resins give plywood other superior characteristics: it resists corrosion and is even fire-retardent."

Call this a *future* plane, if you will. But it is a plane with an immediate future. It may even yet flash down the runways in time to transport equipment to our men on the fighting fronts—another new war-use for Durez resin-bonded plywoods. For plywood, too, has its share in shaping America's arsenal. It builds barracks, airports, "PT" mosquito boats, ponton boats, fighter and bomber training-planes.

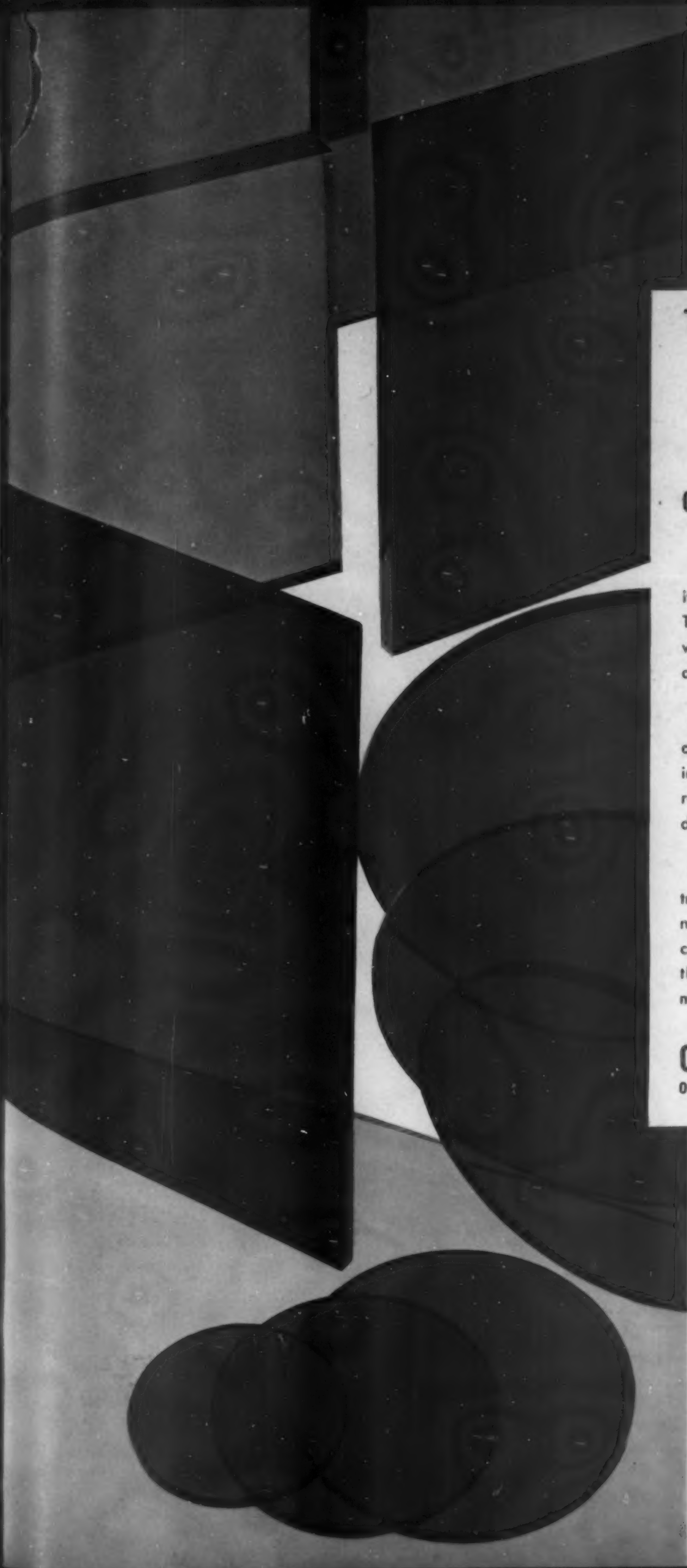
Would you like to learn more about the part Durez plastics and resins are playing in war—and will play in peace? Just write for *your* copy of Durez Plastics News.

DUREZ PLASTICS & CHEMICALS, INC.,
221 Walck Road, North Tonawanda, N. Y.

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

DUREZ

PLASTICS THAT FIT THE JOB



TRANSPARENT SHEETS OF

CATALIN

GET YOU UNDER WAY WITHOUT DELAY!

Catalin possesses physical properties that make it highly desirable for war-production applications. The sheets shown here are quickly available in a wide range of sizes and thicknesses in both colors and water-clear that transmit 80-90% of light.

Catalin is unaffected by most oils, acids, grease or lubricants. It has no tendency to cold flow, is non-inflammable and light in weight. It machines as readily as wood or brass and may be sawed, jigged, drilled, tapped, beveled or formed.

Catalin parts fabricated from transparent, translucent and opaque sheets, rods and tubes are now serving many military, industrial and essential civilian purposes. Our technical staff cordially invites the opportunity of consulting with you on the materials phase of your production problems.

CATALIN CORPORATION

ONE PARK AVENUE • NEW YORK, N. Y.

Catalin is a reg. trade mark

modern plastics

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ABC

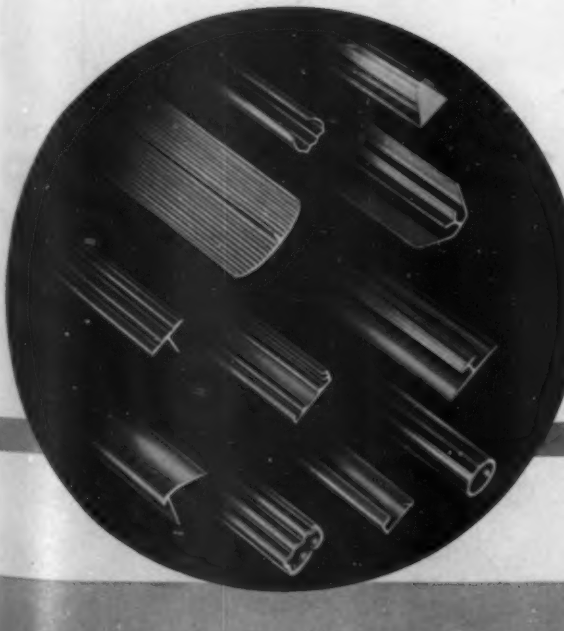
MACHINES FOR PLASTICS EXTRUSION

should be built for the job

SINCE each different plastic has a characteristic behavior, its proper extrusion requires a *machine built for the job.*

National Rubber Machinery Company has recognized this fact by the establishment of a *Plastics Division,* staffed with engineers and chemists who are constantly working with war manufacturers and others in the development of machines for their particular needs. These men know that almost any thermoplastic material can be extruded, provided proper equipment and technique are employed. They have proved it by actual trial runs in National's modern Pilot Plant.

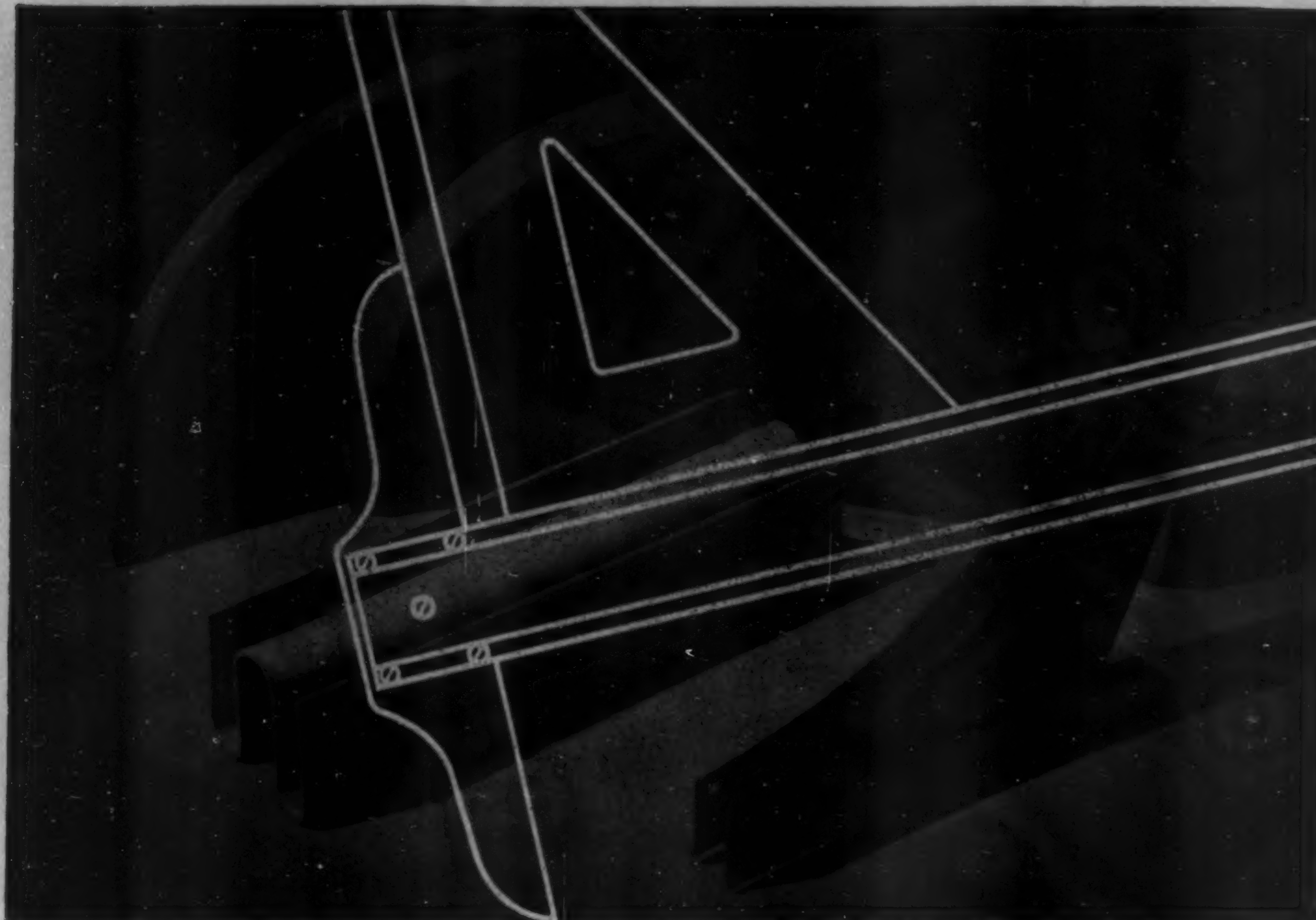
This policy, combined with the wide experience developed in building extruders for the rubber industry, has helped to sell more National plastics extruding machines than all other makes combined.



Plastics Division

NATIONAL RUBBER MACHINERY COMPANY

General Offices: Akron, Ohio



Born on a Napkin at the "Greasy Spoon"!

DESIGNERS often get their inspirations at odd times and places. Many a tablecloth sketch has become a finished product faster because the "dreamers" were thinking in terms of Laminated INSUROK.

Because Laminated INSUROK is versatile and supplied in many grades, it gives designers greater latitude—permits them to solve problems created by lack of other critical materials—helps them meet the demands for faster production without requiring special equipment or causing unnecessary losses because of rejects.

Do you have a war-product, or post-war design problem which might be solved by the use of molded or laminated plastics? If so, write us; we'll be glad to furnish the details and characteristics of INSUROK Precision Plastics.

The Richardson Company, Melrose Park, Illinois; Lockland, Ohio; New Brunswick, New Jersey; Indianapolis, Indiana. Sales Offices: 75 West Street, New York City; G. M. Building, Detroit, Michigan.

INSUROK ***and the experience of Richardson Plasticians are helping war products producers by:***

1. Increasing output per machine-hour.
2. Shortening time from blueprint to production.
3. Facilitating sub-contracting.
4. Saving other critical materials for other important jobs.
5. ✓ Providing greater latitude for designers.
6. Doing things that "can't be done."
7. Aiding in improved machine and product performance.

INSUROK

MADE AND SOLD ONLY BY THE RICHARDSON COMPANY

HOW TO AVOID WELD LINES

in circular pieces of molded "Lucite"

Fig. 2

Dial face molded by General Industries Co., correctly gated with diaphragm which provides for uniform shrinkage in the piece, and the uniform distribution of strain.

FIG. 1

Fig. 4

Faucet handle incorrectly gated with the result that strain is concentrated at gate and at weld line, causing points of weakness.

FIG. 3

Another example of how Du Pont Plastics Technicians have helped to take the guesswork out of molding plastics

ONE OF the tough problems in molding plastic pieces is how to strengthen weld sections . . . or how to eliminate them. Du Pont Plastics Technicians have offered suggestions for handling the problem of weld lines in long pieces like brush handles and tubular shapes such as flashlight and fountain pen cases molded with "Lucite."

What about circular pieces—the automobile dial face and the hot water faucet shown above? After long study and many tests, Du Pont technicians have found a satisfactory way to eliminate the weak spots.

Diaphragm gating is the solution. The "Lucite" flows in from the top at right angles to the flat surface (Fig. 1). It spreads out in one continuous sheet of plastic . . . without any separation or interruption of flow. There is no weld line. There is uniform shrinkage, and any resulting strain is thus uniformly distributed throughout the piece (Fig. 2), not concentrated at a weld line.

In molding the water faucet (Fig. 3), the plastic was shot in at a tangent so as to create a whirlpool flow around an insert. The material, however, separated and a weld line formed. When the insert was removed, the weld line disappeared and a weld line formed directly at the gate, resulting in a similar condition to that obtained when material is injected along the line of radius. In one case, there was concentrated strain at the weld and at the gate (Fig. 4), and in the other case strain concentrated at the gate alone.

So, to avoid a weld and gain greatest strength in circular pieces molded with "Lucite" methyl methacrylate resin, use diaphragm gating. When the piece is molded, take it from the mold and turn it on a lathe to remove the sprue and diaphragm. For more information on diaphragm gating, call on Du Pont Plastics Technicians.

* * *

This is only one instance of the constant search for new and better molding and fabricating techniques, as well as for ways to improve existing methods.

War production has naturally created many urgent new problems, and the facilities and skills of Du Pont Plastics Technicians are mainly dedicated to this work. Please call upon us if we can be of service to you.

Get FREE "Lucite" Manual

Send for a new and comprehensive book on the forming, fabricating, and physical properties of "Lucite" methyl methacrylate resin sheets. It contains information and illustrations of value wherever "Lucite" is used. Write on your business letterhead to E. I. du Pont de Nemours & Co. (Inc.), Plastics Dept. P, Arlington, N. J.

DU PONT

REG. U. S. PAT. OFF.

PLASTICS

Better Things for Better Living
. . . Through Chemistry

Another Installation for Jet Moulding!

Reed-Prentice Plastic Injection Molding Machines are forging ahead in the thermo-setting plastic injection field. By the use of a new heater and nozzle design under license from Plastic Processes, Inc., Cleveland, Ohio, Reed-Prentice machines are now capable of performing jet molding jobs with the customary speed and precision of all Reed-Prentice plastic injection molding machines.

Above is shown a new installation in the plant of Evans-Winter-Hebb, Inc., Detroit, Michigan. Like other progressive molders they select Reed-Prentice machines backed by Reed-Prentice engineering and service.

These machines are available in 4 oz., 6 oz., and 8 oz. capacities.

ARMY E NAVY

REED-PRENTICE CORPORATION

WORCESTER, MASS. U. S. A.

New York Office 75 West St. • Cleveland Office 1213 W. Third St.

THE 4 ABILITIES

GRAPHITIC STEEL HAS ALL FOUR

Graphitic Steel will give you greater ability to produce for Victory now and profits in Peace.

MACHINABILITY

If we gave you results of our own tests, you might think us prejudiced, so we leave it to Graphitic users to tell you from unsolicited letters in our file—"Graphitic Steel machines at least 25% faster than other tool and die steels."

DURABILITY

Again we resort to our letter files. Day after day, users write us and tell us that Graphitic Steel out-wears other steel, particularly where abrasion is a factor.

AVAILABILITY

It is readily available in all tool steel sizes to those who are working on vital Victory contracts.

PRACTICABILITY

Less fabrication cost; more pieces per die or tool; good delivery—all this adds up to practicability.

HELP ASSURE VICTORY

Buy War Bonds. Conserve Rubber. Eliminate Unnecessary Travel. Use the Telephone Only When Important. Salvage All Scrap and Waste Material.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO
Steel and Tube Division

TIMKEN
GRAPHITIC STEELS

Question every fastening job...

ASK — "Why Can't It Be Done the Simple Way . . . with time-saving P-K Self-tapping Screws?"

That question is standard practise with hundreds of engineers and production men who are trying to conserve vital time and labor. They put it to themselves, and to their associates . . . not only at the drafting board but also on the production line.

They don't expect Parker-Kalon Self-tapping Screws to be the best means of making EVERY fastening under ALL conditions. But they know that, for a *very large percentage* of metal and plastic fastening jobs, these Screws offer a combination of ease, speed and real security that no other fastening device or method can match!

How to Save Operations . . . to Save Vital Time and Labor

Make it *your* practise to see that you can't employ the simple Self-tapping Screw method before you put up with a more difficult one. Wherever P-K Self-tapping Screws can be used, operations will be eliminated, vital time and labor will be saved. You merely drive P-K Self-tapping Screws into plain, untapped holes. Such simplicity eliminates tapping and tap maintenance . . . solves the problem of getting scarce taps . . . stops fumbling with bolts and nuts and placing of lock washers . . . does away with inserts in plastics . . . cuts cut riveting and welding in hard-to-get-at places.

SELF-TAPPING SCREWS FOR EVERY METAL AND PLASTIC ASSEMBLY

Call in a P-K Assembly Engineer to check over fastening jobs with you. He can show you how to search out ALL opportunities to apply P-K Self-tapping Screws. And, he'll recommend them only when they will do the job better and faster. If you prefer, mail in assembly details for recommendations.

Change to Self-tapping Screws Over Night . . .

No matter what material you're working with . . . light or heavy steel, cast iron, aluminum, brass, plastics . . . you can adopt P-K Self-tapping Screws to advantage. And you can make the change-over without interrupting production. No special tools or skilled help are required. Parker-Kalon Corp., 190-200D Varick Street, New York, N. Y.

PARKER-KALON
Quality-Controlled
SELF-TAPPING SCREWS

Give the Green Light • to War Assemblies

OUR SALESMEN ARE SLOWLY GOING NUTS

This current, cosmic unpleasantness is cramping our sales style a lot, there's no doubt of that. Our cheeks are continually streaked with tears as we turn down the chance to bid on part after part that we can't touch because of the lack of permitted material or pressure of war business.

We may have no business at all when the new day dawns, but we certainly are going to know how to do a lot of things we would have called impossible a few years back.

Today's problems bring in some of the queerest shapes for production—and the people that bring them in don't know what the words "Can't do" mean. So we take a crack at them and do do. Sometimes we really admit that the results make us admire ourselves. "What, did we do that?"

That's not of national or even local interest now—you're expected to do the impossible and keep your —— —— trap shut, too.

Some time, however, this experience will pay dividends to a selected group of customers—make a note on your pad to look us up—then, not now.

"A Ready Reference for Plastics" written for the layman, is now in a new edition. If you are a user or a potential user of molded plastics, write us on your letterhead for a copy of this plain non-technical explanation of their uses and characteristics. Free to business firms and government services.

ARMY E NAVY

BOONTON MOLDING COMPANY

MOLDERS OF PLASTICS · PHENOLICS · UREAS · THERMO PLASTICS

BOONTON · NEW JERSEY · Tel. Boonton 8-2020

N. Y. Office—Chanin Bldg., 122 East 42nd Street, Murray Hill 6-8540

How to increase production Quickly

with these NEW DELTA POWER-FEED DRILL PRESSES

You can get more output from the same number of operators by utilizing low-cost DELTA Power-Feed Drill Presses. They permit operators to perform additional jobs while the power-feed works automatically and quickly pay for themselves. And here's important news: These new Delta Power-Feed Drill Presses are priced considerably lower than the customary price ranges for drill presses of this quality.

Many Outstanding Features

The unusual design of the Delta Power-Feed unit, which operates directly off the bottom drive of the motor instead of off the spindle, makes possible a wide range of feeds, from .0010 to .016 inches per revolution of spindle in the Slow-speed drill presses and from .0005 to .009 in the High-speed machines. Other special features include: 1. Quick traverse by hand from starting position to work; 2. Instant switching from power to hand feed and reverse without changing or removing parts; 3. Safety lock for preventing damage to drill press when power feed is disengaged; 4. Adjustable automatic stop and return.

This new line includes single and multiple spindle 17" units, in slow speed and high speed models, with table raising or head raising mechanisms, powered with either Delta or standard NEMA frame motors.

Write for SPECIAL BULLETIN

Ask your nearest Delta Industrial Distributor for specifications and prices on the new line of Delta 17-inch Power-Feed Drill Presses or write direct to us.

DELTA MILWAUKEE

THE DELTA MANUFACTURING CO.
624-A E. Vienna Ave., Milwaukee, Wis.
Please send me Special Bulletin on the new line of Delta 17-inch Power-Feed Drill Presses.

Name..

Address..

City.......................... *State*..............

CAN YOU COUNT TO 4?

COUNT: 1-2-3-4-0

Add: CLOVERDALE AVE., DETROIT

You have the easy-to-remember address of the easy-to-work-with extruder of modern plastics.

As you write it down or memorize it, file this information along with it, please:

We are the originators of modern, dry extrusion of thermoplastic materials . . . .

We introduced extruded plastics to automotive, refrigeration, furniture industries....

We're developing new applications of extruded plastics for the Arms and Branches of the Government, for war industry, for essential civilian supply.

To make it easy, just tear out this page and file it under *Plastics*. Call us when you have a problem in our field. We do injection molding, too.

DETROIT MACOID

CORPORATION

12340 Cloverdale Ave. Detroit, Michigan

ORIGINATORS OF DRY PROCESS PLASTIC EXTRUSION


On all fronts
PLASTICS TAKES ITS PLACE IN THE FIGHT FOR THE FOUR FREEDOMS
. . And we in the Insel Company are proud of the part we are playing in this titanic struggle to beat a barbaric foe—and beat them we will!
It is part of our job to help you with tough problems. If the job can be done, we can do it. Call on us.
FLEXIBLE ETHYL CELLULOSE in TUBES, RODS and SHEETS
THERMOPLASTICS . . . Vinylite, Ethyl Cellulose, Cellulose Acetate, Nitrocellulose furnished in tubing, extruded shapes, sheets or molded parts.
Fullest cooperation will be given to manufacturers with priority ratings requiring the above materials.
The Insel Company
ARLINGTON, N. J.

Makalot's

1942 CONTRIBUTIONS TO PLASTICS

☆ War ☆ Civilian Defense ☆ Home Front

1 This container for a supplementary bomb or shell detonator charge is one of the first applications of plastics intended 100% for war use. Makalot 1155 does this job better than anticipated giving, according to a leading molder "perfect wall thickness, uniform shrinkage, and a beautiful molding in general."

THE BOMB-BOOSTER

☆

2 These K.E.M. materials are exclusive Makalot developments to give molders non-critical materials, to help "Keep 'em Molding." They are supplied in the same mesh, bulk and specific gravity as Makalot phenolics. Flow range from 20 to 200.

"K. E. M."
PLASTIC SECOND FRONT

☆

3 Nos. 2962 and 1962, Brown and Black respectively, are perfect for molding around inserts. Large and small pieces of metal seem to have almost an affinity for these materials. There is no cracking when these special Makalot molding compounds are used.

MOLDING AROUND INSERTS

These are only three of the contributions Makalot has made during the year 1942. We pledge continued service and development for the New Year, 1943, and for as long as we are in business. Forward to Victory in '43!

FABRIC & PAPER IMPREGNATING RESINS · MOLDING COMPOUNDS · UREA RESINS & ADHESIVES · PHENOLIC LACQUERS · VARNISHES

"KEEP 'EM MOLDING"

Makalot

CORPORATION

262 WASHINGTON ST., BOSTON, MASS.

Central States Representative: C. R. Olson, 1020 15th St., Rockford, Ill.

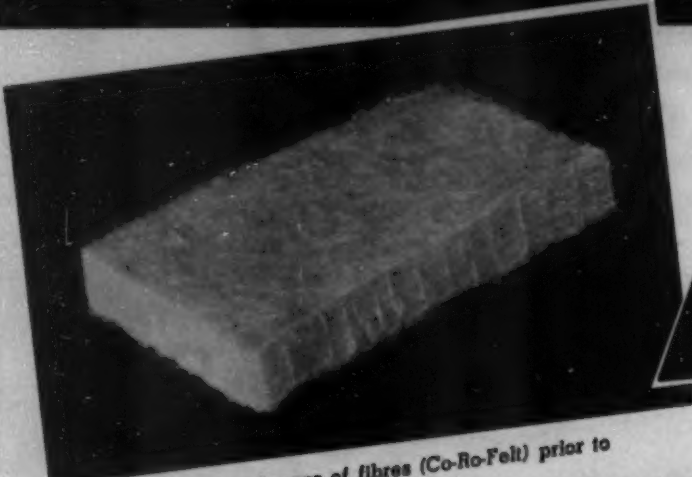
The Independent Producer of Superior Plastics

For High Impact Strength with a Wide Range of Densities

COLUMBIAN CO-RO-LITE

REG. U. S. PATENT OFFICE

The Sisal Filler that's Ready to Mold!



Consolidated mass of fibres (Co-Ro-Felt) prior to application of resin

A balanced assembly of Co-Ro-Lite prepared for molding bobbin head

THOROUGHLY impregnated with thermo-setting resin according to your own specifications for density and specific gravity, Co-Ro-Lite is a light, tough felt of sisal fibres that produces a plastic of high impact strength. All you have to do is to shape, mould and set. Flash moulds may be used.

More — both elasticity and rigidity may be incorporated in the same piece. You'll find this characteristic especially valuable, particularly where a rigid hub with a flexible outer rim is required.

The sisal filler that goes into Co-Ro-Lite is made up of the same type of fibres that are used in strong rope and twine. A patented needling process drives these fibres through and through the assembled mass until it is consolidated into a strong, shock-resisting felt. Sheets and moulded shapes are easily produced. The specific gravity of wood is quickly duplicated. The finished product has a distinctive natural texture, equally suited for cams, gears, bobbin heads, bearings, tension and compression members, abrasive disc hubs, cabinets, scabbards, and other items.

PATENT No. 2,249,888
Other patents pending

- Write or wire for physical data and production recommendations

ALLIED PRODUCTS DIVISION

COLUMBIAN ROPE COMPANY

400-10 Genesee St., Auburn, "*The Cordage City*", N. Y.

Cessna Bobcats

The Air Forces have it . . . and LUMARITH has it!

LUMARITH

REG. U.S. PAT. OFF.

Plastics

CELANESE CELLULOID CORPORATION

Impact strength—the ability to deliver a stinging punch and the toughness to take it! Yes, the men of the sky have it! And in many cases, the cockpits of their 'planes and gliders are enclosed with transparent Aero-Quality Lumarith, the plastic with outstanding impact strength.

Lumarith molding materials, as well as transparent sheets, are giving 'plane and glider parts military stamina at high and low temperatures.

Because Aero-Quality Lumarith Sheets can be formed in single curvatures without heat, replacement after battle is made easy when panel designs take full advantage of this Lumarith property.

Celanese Celluloid Corporation, 180 Madison Ave., New York City, a division of Celanese Corporation of America Sole Producer of Celluloid* (cellulose nitrate plastics, film base and dopes) . . . Lumarith* (cellulose acetate plastics, film base, insulating, laminating and transparent packaging material and dopes) . . . Lumarith* E. C. (ethyl cellulose molding materials) . . . ****Trademarks Reg. U. S. Pat. Off. Representatives:*** **Dayton, Chicago, St. Louis, Detroit, San Francisco, Los Angeles, Washington, D. C., Leominster, Montreal, Toronto, Ottawa.**

The First Name in Plastics

A DIVISION OF CELANESE CORPORATION OF AMERICA

Want "In" on a SECRET?

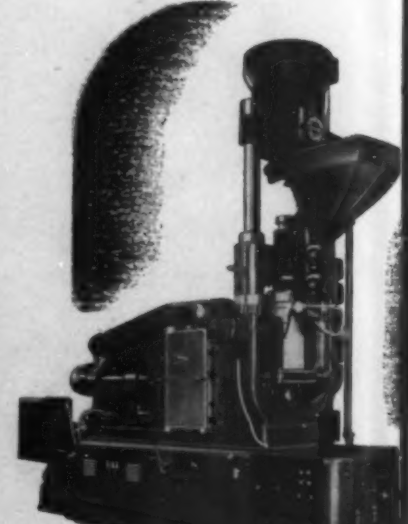
● Of course, it's really no secret why Lester Injection Molding Machines have earned the reputation for producing *more* plastic moldings of *higher* quality at *lower* cost than any other equipment of comparable ratings. It's a matter of correct engineering design.

For instance, let's take a look at the backbone of the Lester—its frame construction. An exclusive feature is the beam frame of heavy cast chromium-molybdenum alloy steel. The beam and base are in the form of a closed "U." This gives 3 to 5 times the cross-sectional area, rigidity and strength of conventional bar-type construction and provides concentrated support exactly where it is needed to resist heavy tension and stresses. Another important advantage of the Lester beam frame construction is improved access to mold space.

Every experienced producer of thermoplastic moldings knows the extreme importance of positive die locking. Operating within the rigid support of the heavy alloy steel beam frame, the Lester patented double toggle link mechanism closes the mold tightly. This reduces to an absolute minimum the flash on moldings. Result—higher quality and lower finishing cost.

But Lester engineering design does not stop with the frame. Lester Injection Molding Machines also offer these advantages—

1. **Vertical heating cylinder with hollow injection plunger,** resulting in faster, more uniform heating of the material.
2. **Positive die locking,** reducing to a minimum the flash on moldings.
3. **Central die adjustment,** assuring absolute parallelism of die plates at all times.
4. **Interchangeable cylinders,** making possible the economical and efficient molding of all types of castings within rated capacity.
5. **Wide range of sizes,** all producing the same high quality moldings. Standard sizes —4, 6, 8, 12, 16 and the new 22-ounce model.



If you have an immediate war production problem in plastics, Lester engineers can help you. Our present manufacture is restricted entirely to equipment to help win the war of production. If you are now laying plans to take advantage of the post-war boom in thermoplastics, investigate the Lester now.

National Distributors
LESTER-PHOENIX INC.
2711 CHURCH AVENUE
CLEVELAND, OHIO

LESTER
INJECTION MOLDING MACHINES

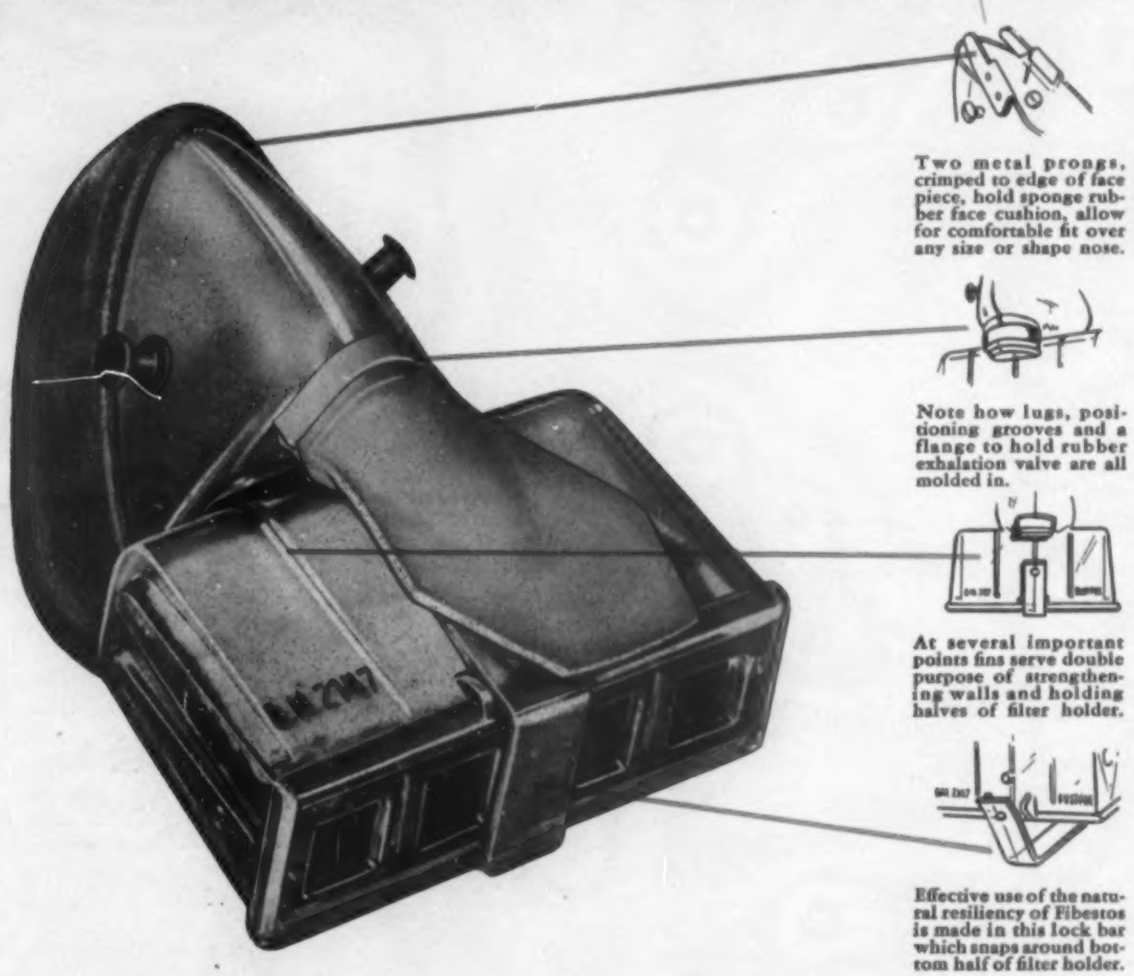
Representatives in:
NEW YORK CITY • DETROIT
LEOMINSTER • LOS ANGELES
CHICAGO • SAN FRANCISCO
CINCINNATI

Foreign Agents:
DOWDING & DOLL, LTD., LONDON, ENGLAND
SCOTT & HOLLADAY PTY. LTD., SYDNEY, AUSTRALIA

REDESIGNED FOR FIBESTOS...NOW YOU CAN SEE WHETHER YOU'RE SAFE FROM DUSTS

LIGHTWEIGHT, compact, sturdy, these new Dustfoe respirators are a triumph of ingenious, practical redesign for plastics. Formerly made of aluminum, face piece and filter holder are now injection molded of transparent Fibestos, Monsanto's tough, durable cellulose acetate. As a result, the wearer can tell at a glance whether filters are dirty or dust is leaking into the mask. He can actually *see* whether or not he is safe from toxic or nuisance dusts.

The entire respirator can be taken apart and reassembled...without tools . . . in a matter of seconds. Fresh filters are easily and quickly installed. All parts can be washed and sterilized . . . below are details of the design.



Two metal prongs, crimped to edge of face piece, hold sponge rubber face cushion, allow for comfortable fit over any size or shape nose.

Note how lugs, positioning grooves and a flange to hold rubber exhalation valve are all molded in.

At several important points fins serve double purpose of strengthening walls and holding halves of filter holder.

Effective use of the natural resiliency of Fibestos is made in this lock bar which snaps around bottom half of filter holder.

The Family of Six Monsanto Plastics

(Trade names designate Monsanto's exclusive formulations of these basic plastic materials)

LUSTRON (polystyrene) • SAFLEX (vinyl acetal) • NITRON (cellulose nitrate) • FIBESTOS (cellulose acetate) • OPALON (cast phenolic resin) RESINOX (phenolic compounds)

Sheets • Rods • Tubes • Molding Compounds • Castings • Vuepak Rigid Transparent Packaging Materials

MONSANTO PLASTICS

SERVING INDUSTRY...WHICH SERVES MANKIND

Credit for an outstanding job of design and molding goes to Plastic and Rubber Products Company of Los Angeles, molders, and B. F. McDonald Company, Los Angeles, manufacturers of Dustfoe respirators. Credit for an "assist" in specifying the best possible material for the job and helping iron out production problems goes to Monsanto technical service engineers...a very helpful and useful group of men to have at your service on *any* job, as many a molder and fabricator will testify. For their help on *your* war or essential civilian jobs, inquire: MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield, Massachusetts.

HOW TO GET THE MOST OUT OF YOUR LATHES

No. 4 in a series of suggestions made by the South Bend Lathe Works in the interest of more efficient war production

Adjust the dovetail gibs to insure accurate work

Keep Your Lathes in Trim

The old proverb, "An ounce of prevention is worth a pound of cure", is as applicable today as when first expressed by some long forgotten sage. Lathes and other modern precision tools must be "kept in trim" if they are to give the long, trouble-free service that is expected of them.

Although the adjustments required to "keep the lathe in trim" are few and simple, they are important and should not be neglected. And even though the lathe is rigidly constructed and will stand some rough handling, it should be protected from unnecessary abuse.

Power Transmission

Maximum efficiency as well as maximum production depends on the effective transmission of power to the lathe spindle. The motor, being the source of power for the lathe, should develop its full rated power and should operate at a uniform speed. If for any reason the line voltage drops below the rating for which the motor is constructed, the motor will not deliver full power. For this reason the current should be checked at the motor occasionally and the correct line voltage maintained.

To transmit the power from the motor to the lathe spindle efficiently, all belts must be properly adjusted. If the belts are too loose they will slip, and if they are too tight they will cause loss of power through friction. The belts should be just tight enough to transmit the required power without slipping. Precision belt tension adjustments provided on South Bend Lathes make it easy to keep the motor V-belts and flat cone pulley belts properly adjusted.

Dovetail Slide

All dovetail slides on South Bend Lathes are equipped with gibs which may be adjusted to eliminate play. When the adjustment of the dovetail gibs is neglected, looseness of the slides may cause the tool to chatter or may result in inaccurate work.

The gibs should be tight enough to assure the necessary rigidity, but not tight enough to bind and make the dovetail slides hard to operate.

Tailstock Adjustment

The alignment of the tailstock top should be checked frequently as any misalignment will cause the lathe to turn a taper. To test alignment, place a bar of steel, 1 inch or larger in diameter, between centers and machine two collars of equal diameter not less than 4 inches apart. Then, take a very light finishing cut across both collars without changing the setting of the cutter bit. Measure both collars with a micrometer. Any difference in the diameters indicates misalignment. Correct the alignment by turning the tailstock top set-over screws until both collars can be turned to the same diameter.

Don't Abuse the Lathe

Just because the lathe is made of iron and steel is no reason to expect it to stand abuse. Never use the lathe bed as an anvil. Don't use a crowbar to straighten a shaft between the lathe centers. Never rap chips out of a file by striking it on the lathe bed or tailstock.

Write for Bulletin H4

Bulletin H4 giving more detailed information on keeping the lathe in trim will be supplied on request. Also reprints of this and other* advertisements and bulletins in this series. State quantity wanted.

*H1, "Keep Your Lathe Clean"
H2, "Oiling the Lathe"
H3, "Installation and Leveling of the Lathe"

SOUTH BEND LATHE WORKS

South Bend, Ind., U. S. A. **Lathe Builders for 36 Years**

THE SILHOUETTE YOU CAN GRASP

The sky suddenly black with planes—travelling at a speed where color and insignias have no meaning.

Our men have a split second to make the decision as to which plane is friend and which is foe.

Only by silhouette identification can this be accomplished. Careful training of our flyers through three-dimensional accurate scale-models is today saving the lives of our boys and our own planes.

This training likewise helps our men in quickly identifying enemy planes and attacking them at their most vulnerable point.

Cruver showed the way in converting these three-dimensional scale-models to an available thermo-plastic, rapidly molded by the automatic injection molding process, and has developed special equipment for the progressive production of these planes.

This is one of Cruver's daringly successful plastic developments for war. More will be shown in subsequent advertisements.

Cruver

MANUFACTURING COMPANY

NEW YORK
2 WEST 46TH STREET

CHICAGO
2456 W. JACKSON BLVD.

SPECIALISTS IN CONVERTING PLASTICS TO WAR

Sanding and Finishing Problems ?

GET THE PROMPT SERVICES

OF ONE OF OUR

ABRASIVE ENGINEERS

Phone the Nearest Branch

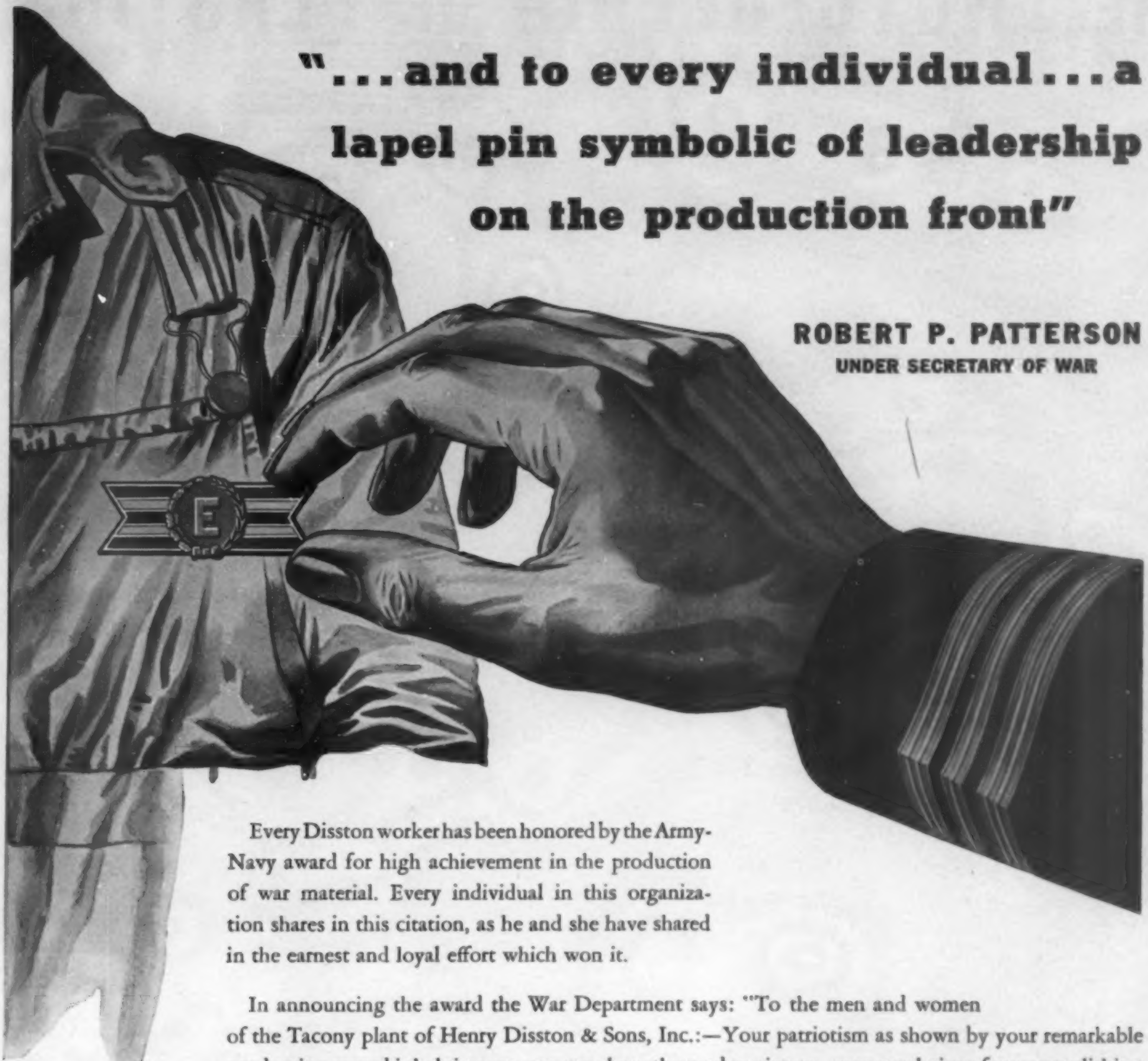
Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Grand Rapids, High Point, Indianapolis, Los Angeles, New York, Philadelphia, St. Louis, San Francisco, Tacoma

BEHR-MANNING
(DIVISION OF NORTON COMPANY)
Troy, N. Y.

Abrasives for the Most Critical Users
Since 1872

"...and to every individual...a lapel pin symbolic of leadership on the production front"

ROBERT P. PATTERSON
UNDER SECRETARY OF WAR



Every Disston worker has been honored by the Army-Navy award for high achievement in the production of war material. Every individual in this organization shares in this citation, as he and she have shared in the earnest and loyal effort which won it.

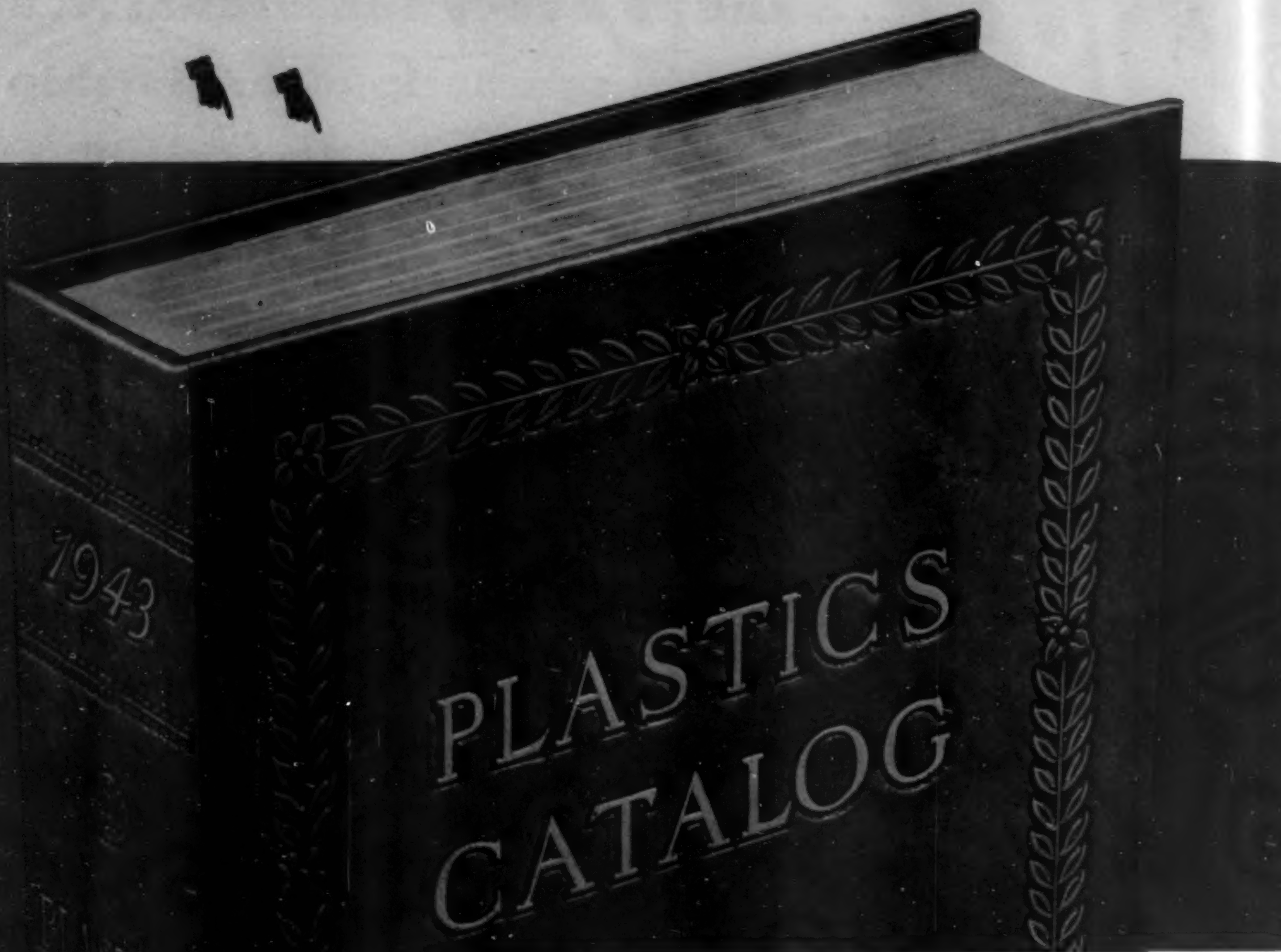
In announcing the award the War Department says: "To the men and women of the Tacony plant of Henry Disston & Sons, Inc.:—Your patriotism as shown by your remarkable production record is helping our country along the road to victory...congratulations for accomplishing more than seemed reasonable or possible a year ago."

The "E" burgee that flies above the Disston plant and the "E" badge that Disston men and women wear are more than symbols of a year's accomplishment—they are an inspiration to achieve *more*, an incentive to keep on producing beyond what seems "possible."

HENRY DISSTON & SONS, INC.
Tacony, Philadelphia, Pa., U. S. A.

Disston workers are producing to the utmost of their ability: Armor Plate for the Air Corps and Army motorized equipment . . . Steel for Ordnance—37 mm. guns, Steel for torpedo and rifle parts . . . Motor driven chain saws for Army Engineers . . . Jungle Knives for the Quartermaster Department . . . Huge quantities of saws, files and other tools for other government departments as well as for thousands of industrial plants making products essential to victory . . . at the same time Disston workers are producing the Company's regular products for the essential needs of customers.

THE ENCYCLOPEDIA OF PLASTICS



CONSULTED by procurement and planning officers in practically every branch of the Army and Navy; workbook and desk companion to the key executives in the largest war producing plants in America, the 1943 PLASTICS CATALOG has won an enviable place as the complete, reliable and authoritative encyclopedia of plastics.

In its 864 pages are to be found 147 separate articles on every commercial plastic material, synthetic rubber, fibres, solvents, plasticizers; all the methods of molding, fabricating, extruding and laminating; flow sheets of plastics manufacture; coating materials; machinery and equipment used to manufacture plastics; and including 8 separate directories to the manufacturers and suppliers of all goods and services in the plastics industry; and 5 exclusive charts: (1) PLASTICS PROPERTIES CHART; (2) CHEMICAL FORMULAE OF PLASTICS; (3) RESINS AND SYNTHETIC RUBBERS SOLVENTS CHART; (4) PLASTICIZERS CHART; (5) PROPERTIES OF SYNTHETIC RUBBERS. These charts, alone, are worth more than the selling price of the entire Catalog.

Copies may still be purchased at $5.00 each. Publishers urge orders be placed immediately, in view of limited supply.

PLASTICS CATALOGUE CORP.

122 East 42nd Street • New York City

Where corrosion MIGHT LOSE A BATTLE OR EVEN A WAR....

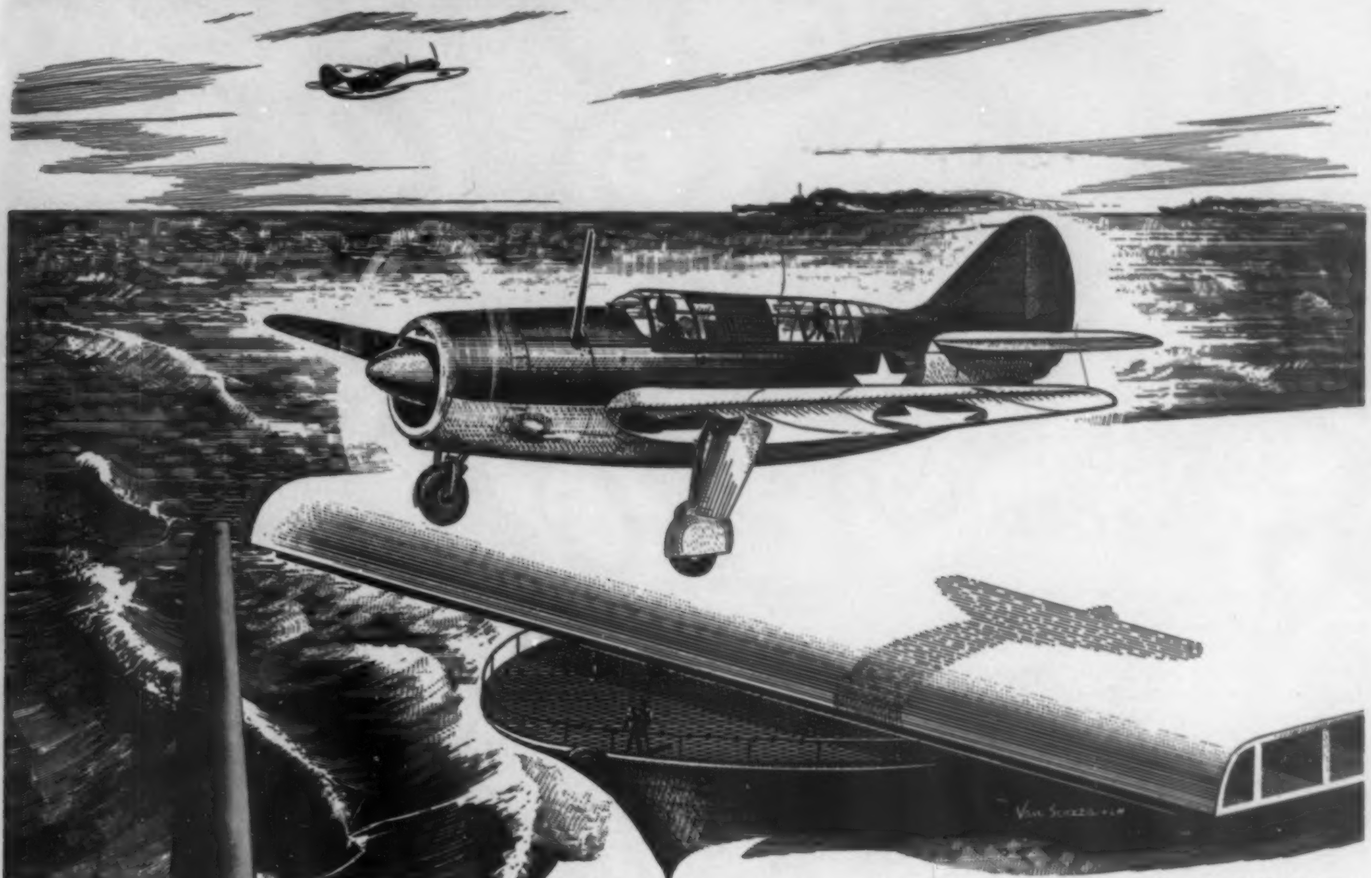


Illustration courtesy of Curtiss-Wright Corp.

CONTINENTAL–DIAMOND *plastics stand guard—*

REPLACING an important quantity of a strategic metal, the DILECTO radio antenna mast illustrated also contributes importantly to our war effort by helping insure uninterrupted radio reception under the most severe and adverse conditions.

The properties of Dilecto* (Grade C) which make this antenna mast stand the gaff are:

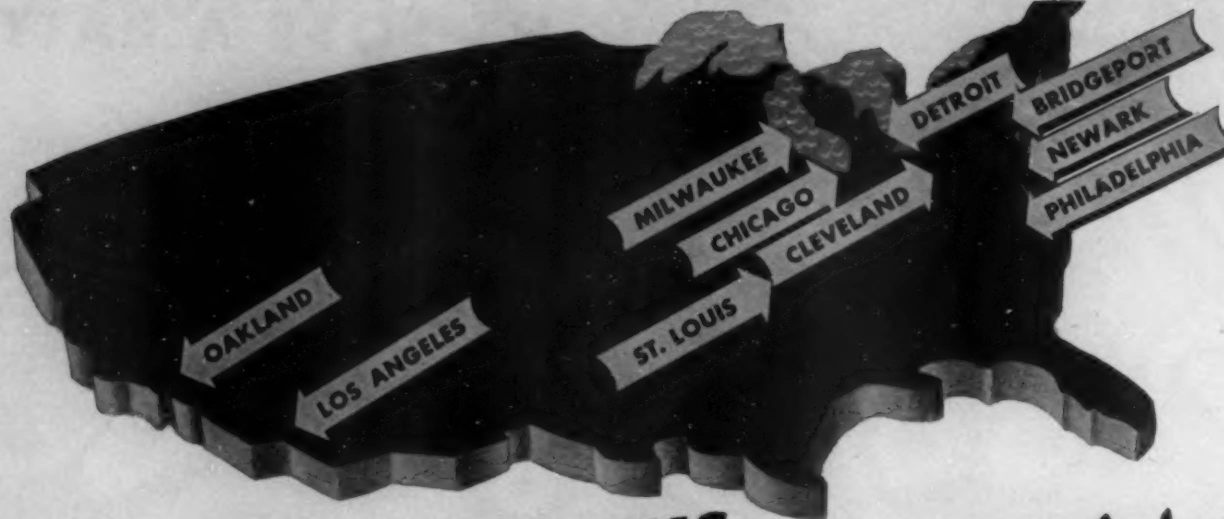
1. Great physical strength—
   Tensile Strength 9,500 PSI
   Compressive Strength 38,000 PSI
2. Adaptability of design—Readily molded or machined.
3. High dielectric properties—150 VPM on 1/8" thickness.
4. NON-corrosive.
5. Light weight—Specific gravity 1.36—about half the weight of aluminum, one-seventh that of steel

Again a C-D replacement material has proved to be a BETTERMENT.

★ Grade C DILECTO is a canvas base laminated plastic, one of many DILECTO Grades. It is a structural material. Other grades excel in dielectric properties; chemical resistance; low dielectric loss. . . . Catalog DO 41 gives complete technical data on all grades. Send for a copy.

Continental-Diamond FIBRE COMPANY

Established 1895 . . Manufacturers of Laminated Plastics since 1911 — NEWARK • DELAWARE



PLASTICS STUDY-FORUMS *for the convenience of all industries*

FORUMS ARE IN THESE CITIES

CHICAGO: 626 LaSalle-Wacker Bldg. · Central 8373—**DETROIT:** 728 Boulevard Bldg. · Trinity 2-1007—**CLEVELAND:** 1414 Williamson Bldg. · Cherry 0978—**NEWARK:** 5 Commerce Street · Mitchell 2-1377—**MILWAUKEE:** 5182 Plankington Bldg. · Daly 4458—**PHILADELPHIA:** Room 2126, 123 So. Broad St. · Pennypacker 0788—**ST. LOUIS:** Rm. 1021, 411 N. 7th St. · Central 3088—**LOS ANGELES:** 718 North San Fernando Rd., Burbank · Charleston 6-5732—**OAKLAND:** 907 Syndicate Bldg., 1440 Broadway · Twinoaks 4200—**BRIDGEPORT:** 303 Bridgeport-City Trust Bldg. · Phone 6-1189

New Forums: Pittsburgh, Minneapolis, Jersey City, Baltimore.

So that engineers, designers, purchasing agents, executives, salesmen, and others interested in Plastics, may obtain authentic, dependable information on all phases of Plastics materials and manufacturing methods—Plastics Institute is conducting a series of Study-Forums in various industrial centers. Each Forum is conducted by a recognized local Plastics authority.

Discussions are based upon Plastics Institute Lesson Assignments. All Forums are under the supervision of John Delmonte and Dr. John P. Trickey. Two-hour evening sessions are held twice each week for twenty weeks.

The Plastics Institute will consider invitations from local groups in any city, to conduct these popular Study-Forums.

The letter below clearly shows the practical value of the Study-Forums as conducted by the Plastics Institute—and the advantages of having a thorough knowledge of Plastics.

THE RED RIVER LUMBER COMPANY

CALIFORNIA SOFT PONDEROSA and SUGAR PINE

LUMBER MOULDING PLYWOOD PANELS

Mill, Factories and General Sales WESTWOOD, CALIFORNIA

2452 South Loomis St. TELEPHONE CANAL 7040 CHICAGO, ILLINOIS

July 23, 1942

Plastic Industries & Technical Institute
221 North LaSalle Street
Chicago, Illinois

Gentlemen:

The writer recently completed a course of study in Plastics at your Institute. This education has placed me in a position where I am now able to take advantage of many opportunities developing in this relatively new industry.

Several weeks ago, I became interested in a very important Government order. Equipped with this new knowledge, gained through your course and the kind assistance of my former instructor, Mr. J.C. Kasemeier, I have submitted samples and specifications. Advice received from Washington today indicated that all other competition has been overcome by the supiority of my samples over the others.

Incidentally, there are several other items which I have been requested to consider manufacturing and, without a doubt, I will be operating my own business very shortly. Any success developed along these lines will be the result of the thoroughness of your course and I feel that the cost of this training will come back to me a thousand fold.

May I congratulate you on the splendid manner in which the course is written and your choice of capable instructors.

Yours very truly,

Randolph R. Stark

Francis A. Gudger
President

John Delmonte, *Technical Director* — Dr. John P. Trickey, *Assistant Technical Director*

ADVISORY BOARD

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NEW YORK 1220-A Chanin Bldg. — **LOS ANGELES** 182 S. Alvarado St. — **CHICAGO** 626-A LaSalle-Wacker Bldg.

MEMBER: SOCIETY OF THE PLASTICS INDUSTRY

ANSWERS TO YOUR QUESTIONS ABOUT

Plexiglas *and* Crystalite

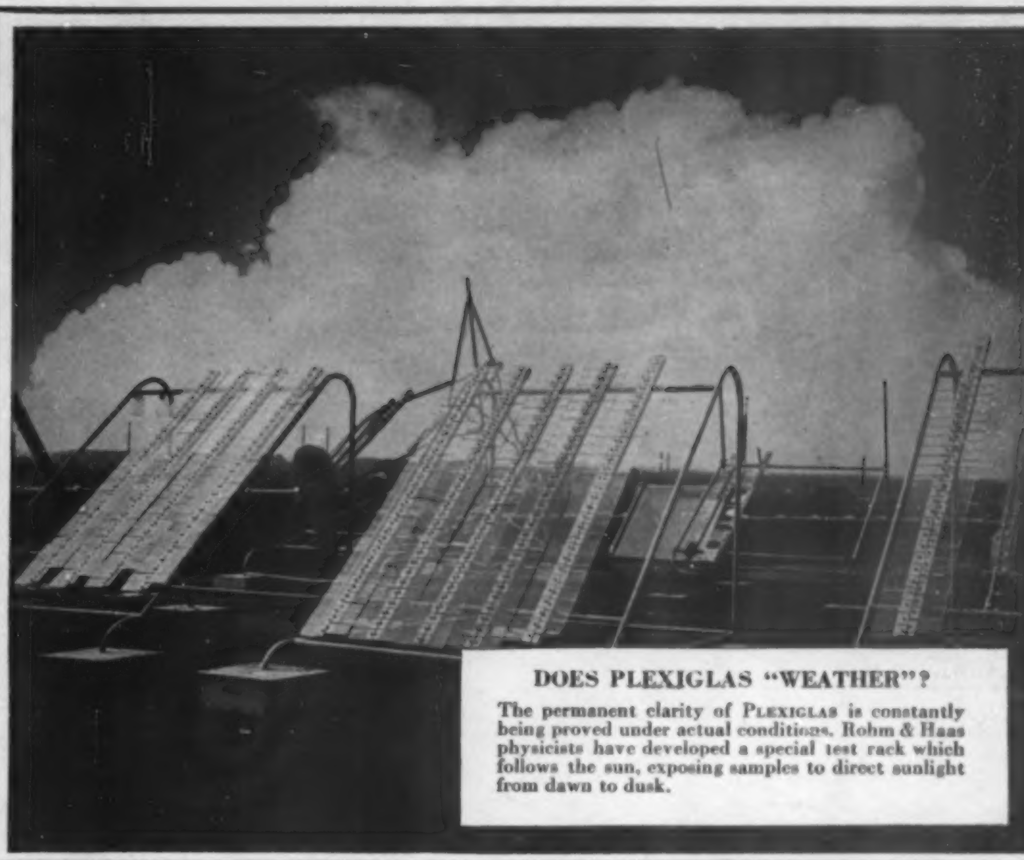
FROM THE NEW ROHM & HAAS *PHYSICS LABORATORY*

UNDER war-time pressure, years of research and testing are being packed into a few short months at the new Rohm & Haas Physics Laboratory.

Here, equipment is available for all of the standard tests on plastics. Here, twenty-four hours a day, control tests are conducted to see that every batch of PLEXIGLAS and CRYSTALITE meets high optical and mechanical standards.

In addition, special equipment is designed and constructed to solve special war-time problems—to determine, for example, the behavior of PLEXIGLAS panels under the conditions at which high altitude planes must operate—to observe how tensile and flexural strength are affected by temperature changes—to select suitable cleaners and polishes for PLEXIGLAS—to find the answers to hundreds of other questions, Army, Navy, and war production engineers ask about PLEXIGLAS and CRYSTALITE.

Today, this intensified research is helping to win the war. Tomorrow, it will help you to design better peace-time products.



DOES PLEXIGLAS "WEATHER"?

The permanent clarity of PLEXIGLAS is constantly being proved under actual conditions. Rohm & Haas physicists have developed a special test rack which follows the sun, exposing samples to direct sunlight from dawn to dusk.

WHAT ABOUT BEARING STRENGTH?

A recent Physics Laboratory report based on tests similar to that shown above covers the pin-load bearing strength of PLEXIGLAS in detail. Write for a copy on your letter-head.

BRING YOUR PLASTIC PROBLEMS TO US

If you have a plastics problem, the answer can probably be found in our growing fund of technical data. Call our nearest office.

Rohm & Haas Company, Washington Square, Philadelphia, Pa.; 551 Fifth Ave., New York, N. Y.; 8990 Atlantic Blvd., South Gate, Los Angeles, Calif.; 619 Fisher Bldg., Detroit, Mich.; 930 No. Halsted St., Chicago, Ill. *Canadian Distributor*—Hobbs-Glass Ltd., Montreal, Canada.

THE CRYSTAL-CLEAR ACRYLIC PLASTICS

PLEXIGLAS

SHEETS AND RODS

★

CRYSTALITE

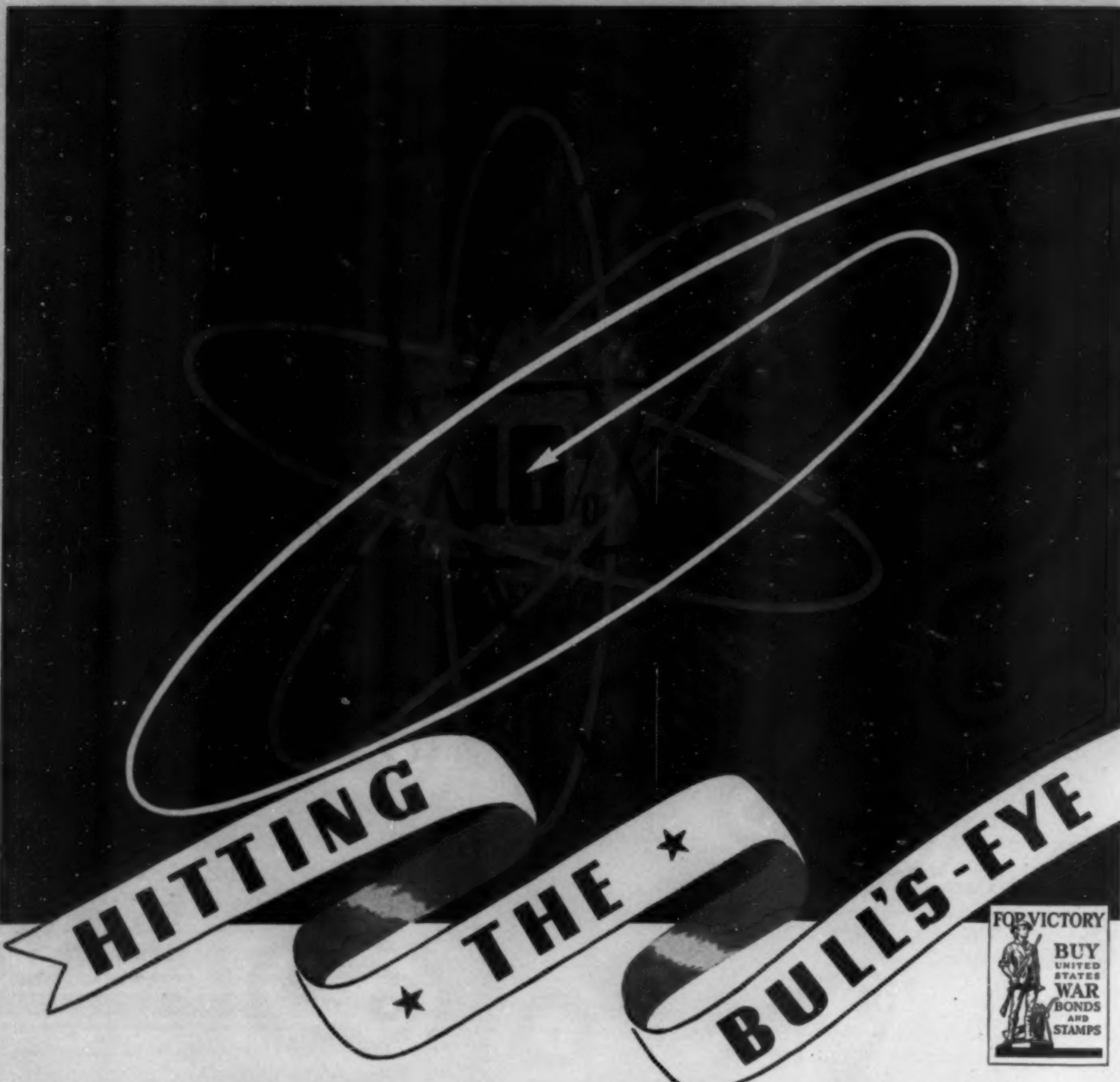
MOLDING POWDER

PLEXIGLAS *and* CRYSTALITE *are the trade-marks, Reg. U. S. Pat. Off., for the acrylic resin thermoplastics manufactured by Rohm & Haas Company.*

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA, PA.

Manufacturers of Leather and Textile Specialties and Finishes . . Enzymes . . Crystal-Clear Acrylic Plastics . . Synthetic Insecticides . . Fungicides . . and other Industrial Chemicals



★ At Midland "War Work" means far more than just the manufacture of war materiel . . . It means the cooperative effort of management and employee in actively backing every important phase of America's war effort.

★ In manufacturing—Midland has hit the bull's-eye by repeatedly beating deadlines on plastic molds, hobbings and essential manufacturing dies . . . Now Midland workers hit the bull's-eye again—this time by subscribing 100% to the 10% war bond savings plan.

MIDLAND DIE AND ENGRAVING COMPANY

1800 W. BERENICE AVENUE · · · CHICAGO, ILLINOIS

Makers of Plastic Molds • Die Cast Molds • Engraved Dies • Steel Stamps • Hobbings • Pantograph Engraving

PLASTIC LINERS *for Combat Helmets*

Light plastic liners for the new shrapnel-proof helmets . . . a radical departure from and improvement on the helmets of World War No. 1!

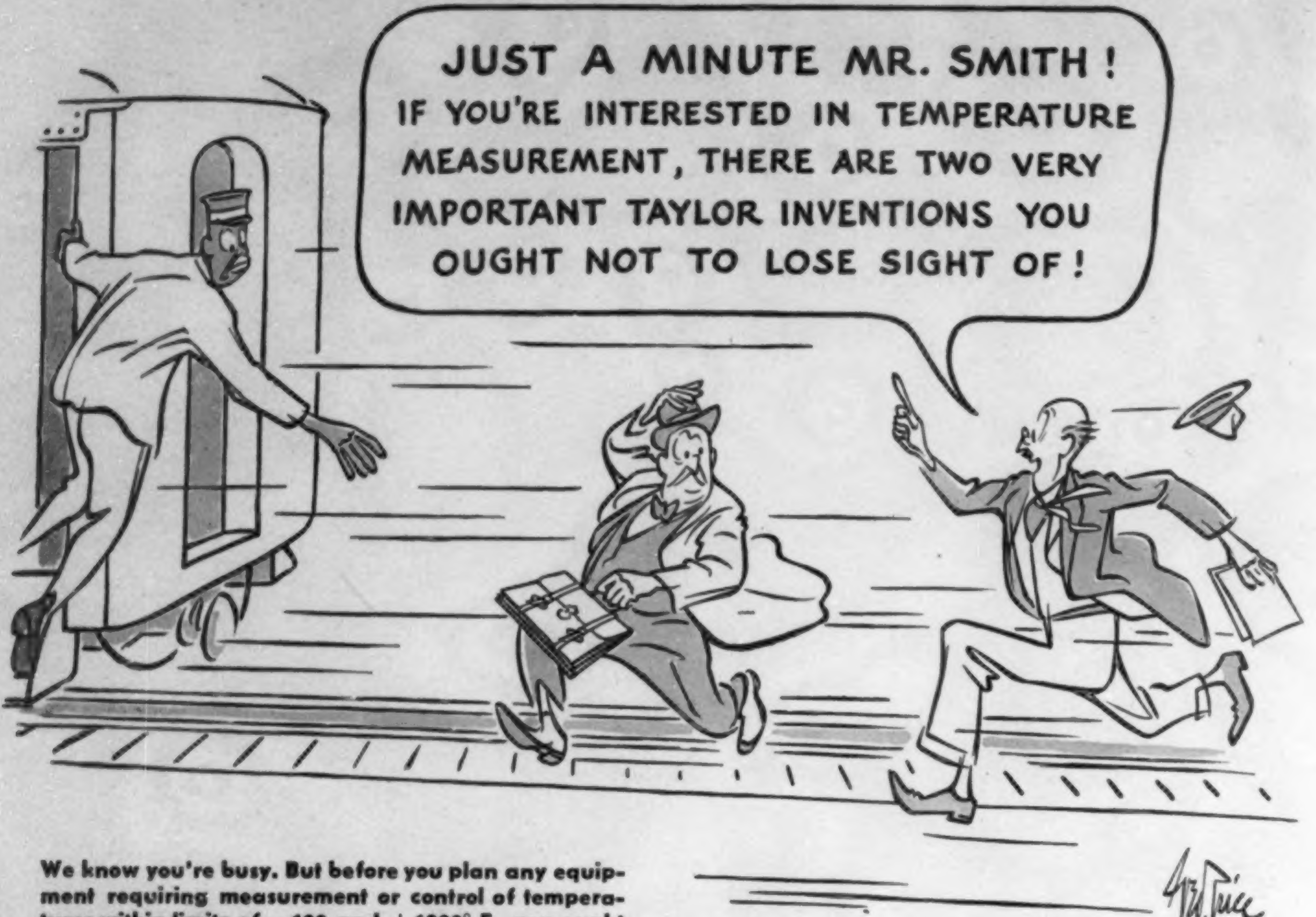
Yes, plastics are playing an important part in this war. For many articles they are inherently superior to metal. They are pinch-hitting on many a job where metals are just not available. And as with metals, surfaces and edges often need cutting down, polishing and buffing to make them smooth and to promote precision in manufacture.

In the field of plastics, as of metals, Lea Technicians are lending a helping hand on such problems. They are thoroughly skilled in the art of preparing and finishing surfaces, and they have the compounds with which to work. The Lea Method plus Lea Compound or Learok, or a combination of both, is now standard practice in hundreds of plants.

THE LEA MANUFACTURING CO.

WATERBURY, CONN.

Burring, Buffing and Polishing . . . Specialists in the Development of Production Methods and Compositions



We know you're busy. But before you plan any equipment requiring measurement or control of temperatures within limits of --100 and +1000° F., you ought to know about these two Taylor developments:

1. Mercury tubing that can't tell a lie! Imagine being able to have all the advantages of a mercury-actuated recording thermometer—on an application requiring long lengths of connecting tubing! It's long been an established fact with Taylor Accuratus Tubing. This precision-bore tubing, a Taylor invention, has a special alloy wire inside, with a coefficient of expansion so related to the tubing and the mercury that any variations in ambient temperatures along the way are counteracted on the spot. The result is *accurate* temperature recordings.

2. Accurate temperatures several times faster! Where a separable well is required to protect the temperature-sensitive bulb from erosion or corrosion (or to permit removal of the bulb without disturbing the contents of the equipment) there always used to be a considerable time lag in transmitting temperature changes to the bulb. But that was before Taylor "Thermospeed" came along. With Taylor Thermospeed Separable Well construction, response is several times faster than the average separable well tube system, with minimum bulb conduction error.

CALL YOUR TAYLOR FIELD ENGINEER. These are only two of the many "plus-values" which have given Taylor its reputation for leadership in the temperature field. If you need indicating, recording or controlling temperature instruments, your Taylor Field Engineer will determine whether a mercury, vapor or gas-actuated system is best for your particular requirements. And from a wide variety of bulb and well constructions and connecting tubings at his command, he will specify the other details which assure the accuracy, responsiveness, and long life characteristic of Taylor Instruments. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. *Instruments for indicating, recording, and controlling temperature, pressure, flow, humidity, and liquid level.*

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

★ ★ ★ KEEP ON BUYING U. S. WAR SAVINGS BONDS AND STAMPS ★ ★ ★

Built to "take it"—

American Bombers of the type shown have done splendid work over Japan, Africa, Germany and the Southwestern Pacific. Despite ground or aerial opposition, they rarely fail to deliver their cargo!

—and to deliver the goods as well!

War-time Developments

indicate Peace-Time Trends...

Look to Celluplastic instead of metal and other strategic materials for *shatterproof* containers that are destined for War Essentials. They are proving *their* ability to "take it", and perform their tasks with uniform satisfaction.

CELLUPLASTIC

is available for *your* War Essential work. Bear it in mind for tools that need protection; for spare parts or for repair parts in everyday production requirements.

"PIONEERS IN PLASTICS"

FIRST IN CELLUPLASTICS

HYCOLOID-CLEARSITE

Celluplastic Corporation

EXTRUSION AND INJECTION MOLDERS

40 AVENUE L NEWARK, N. J.

THE BATTLE FLAG OF WORKERS FLIES AT TEXTILEATHER!

● Now this cherished Battle Flag of Workers—the Army-Navy "E" for Excellence in war production beyond the call of duty—is awarded to the employees and management of Textileather and Toledo Dye Works.

Their battle deeds don't make the headlines . . . nevertheless their work is vital to every action on land, sea and air . . . for theirs is the tremendous task of helping to *equip* the men behind the guns.

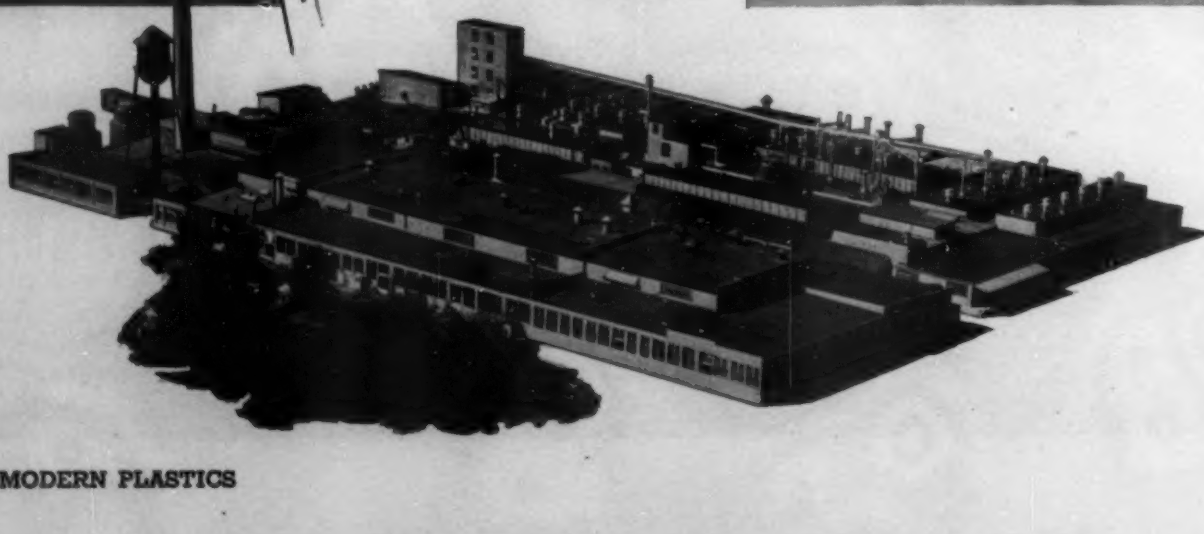
Among the employees of Textileather and Toledo Dye Works . . . this highest production award is deeply appreciated. They'll fly this flag proudly . . . a symbol of each worker's pledge for continuing self-sacrifice and effort . . . to hasten the day of Victory!

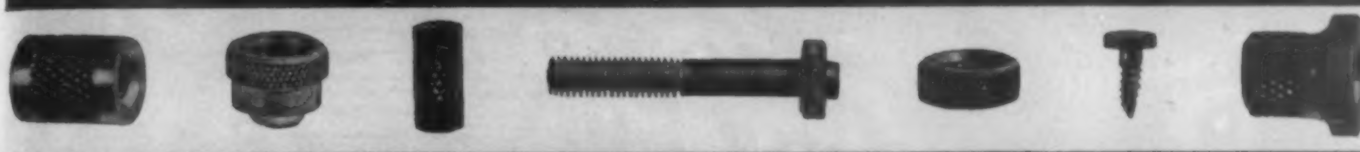
TEXTILEATHER CORPORATION

AND TOLEDO DYE WORKS DIVISION

TOLEDO, OHIO

TEXTILEATHER

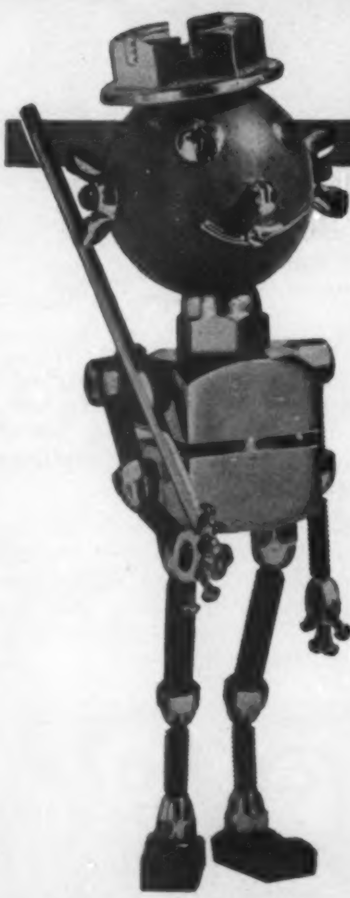




WHAT TO DO

If You Need

FASTENING DEVICES



Use THE *NATIONAL* QUALITY LINE...or if more help is needed...get in touch with The NATIONAL Research Department

From the tiniest screw, bolt, nut or rivet to the very largest equipment, so complete and diverse is The National Screw & Mfg. Company line, that we can supply or make most any size or type of fastening.

National research men are constantly looking for new and better methods for the use of fastening devices in industry. Thus, if you have any questions or if you need help to solve any particular problem, write us at once. We'll give you full benefit of our 53 years of headed and threaded product experience.

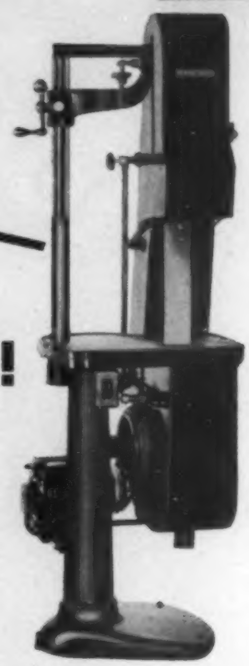
National
HEADED AND THREADED
PRODUCTS

THE NATIONAL SCREW & MFG. CO., 2440 E. 75TH ST., CLEVELAND, O.

Out with the Old . . . and in with the NEW!

PORTER-CABLE
Wet-Belt SURFACERS
FOR BETTER PLASTIC FINISHING

STOCKING FORMS MUST BE REALLY SMOOTH, MUST HOLD UNIFORM COLOR—and this group of B-6 Porter-Cable machines really does a job! They're clean and slick when they leave these Surfacers!



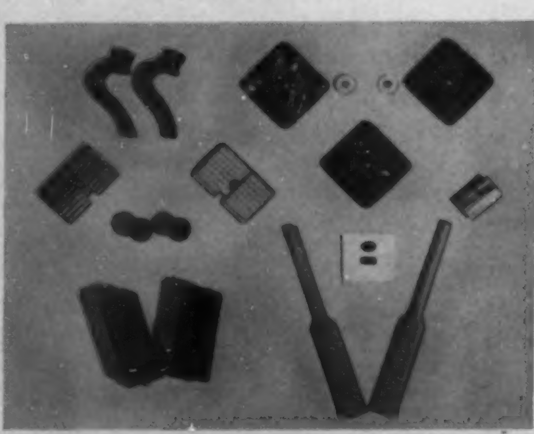
5 to 50 Times FASTER!

Finishing of your plastic pieces can now be as up-to-the-minute as your selecting of the right materials or the best molding methods. Here's the way you do it—with the revolutionary Wet-Belt Surfacer developed by Porter-Cable. More output! Finer work! Less spoilage! Big cost savings!—all these results are today demonstrated facts.

You can now dispense with hand work and get cleaner, high-speed cutting on either straight, curved or irregular plastic surfaces. The *Porter-Cable Way* grinds uniformly, with straight grain—no waves. The abrasive belt constantly washes free of loading. You stop plastic flow, heating, chipping, discoloring . . . and eliminate all the dangers of dust formation.

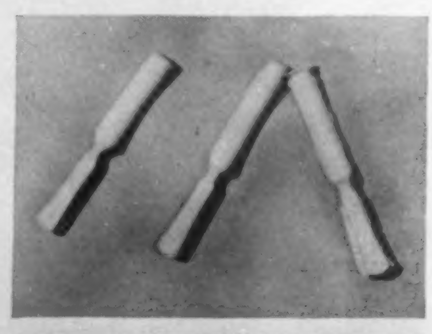
Take a look at some of the finishing jobs shown here—then send for our New Booklet describing many of the amazing applications of Porter-Cable Wet-Belt Surfacing which save parts makers time and money and relieve production jams in a jiffy. Sent you FREE on request. Our recommendations on parts submitted, furnished without obligation.

UNSKILLED OPERATORS DO THEIR FULL SHARE AT THE START! This battery of Porter-Cable G-4 machines doing burring and polishing flats, is run by women with little experience—who turn out accurate work in record time!

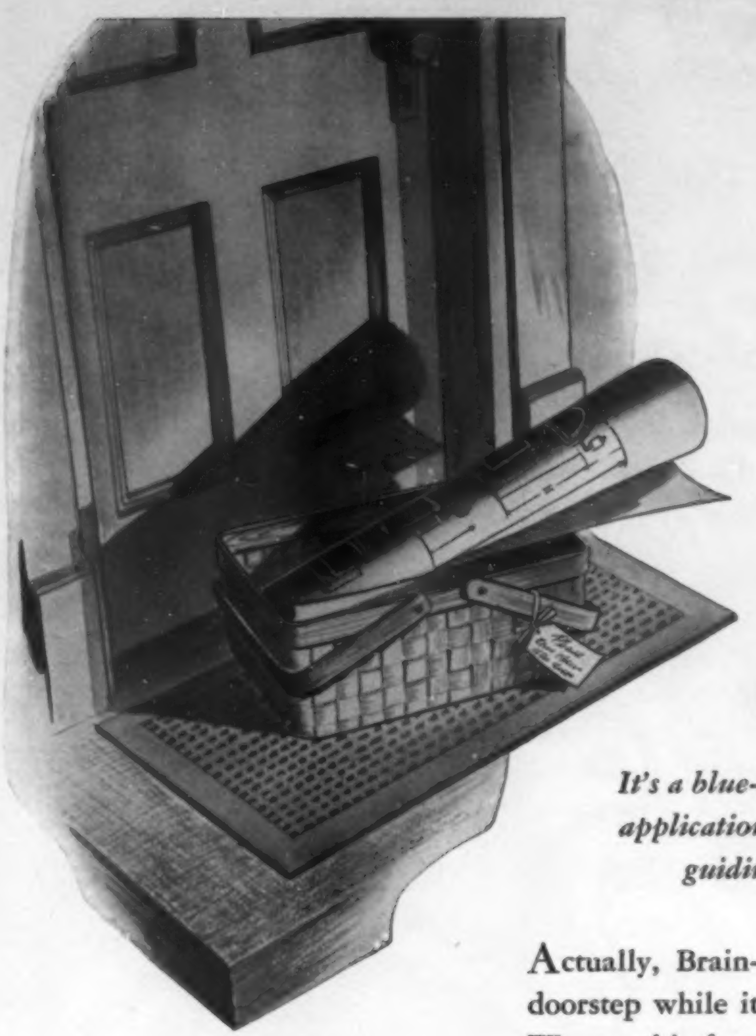


PLASTIC PARTS of varied shapes like these are being finished and polished by Porter-Cable Wet-Belt Surfacers.

PORTER-CABLE MACHINE CO.
1606-1 N. SALINA ST.,
SYRACUSE, N. Y.



WHAT A DIFFERENCE—in these brush handles right out of the mold and right after finishing! See how smoothly B-6 takes off the flashings and gate!



THIS BRAIN-CHILD NEEDS A GUARDIAN QUICK!

It's a blue-print (yours, perhaps) for a Plastic application. And it's overdue for the firm, guiding hand of a custom molder.

Actually, Brain-Child should be put on your molder's doorstep while it's still a twinkle in your designer's eye. We say this from harsh experience . . . and here's why.

Every plastic part is designed for a definite function. To-day there are at least 200 basic molding compounds several of which might supply the necessary characteristics. Most of these are further divided into special-purpose sub-categories. Your molder not only can help to make the right selection, but will suggest variations in design necessitated by the characteristics of the molding compound selected. And how *they* vary!

In addition, a custom molder such as ourselves knows the short cuts of design that keep mold costs down . . . speed up molding cycles . . . eliminate finishing operations. Consulting him early will save you time and money.

FOR YEARS, design and engineering have been as much a part of our service as the making of molds and the production of finished parts. Our old customers (and many new ones) are thinking ahead with us along those lines to-day. May we explain?

CHICAGO MOLDED PRODUCTS CORPORATION

Precision Plastic Molding

1046 North Kolmar Ave., Chicago, Illinois

COMPRESSION INJECTION AND TRANSFER MOLDING OF ALL PLASTIC MATERIALS

In Service

AT THE FRONT —AND AT HOME

● At the front — on land, at sea and in the air — and at home, REILLY INDUR PLASTICS are "in the service." Their light weight, structural strength, high electrical resistance and ability to withstand heat, moisture, oils and most acids, are among the characteristics that qualify INDUR PLASTICS for war service. The use of INDUR is saving both time and materials in the production of many parts, instruments and devices which are directly or indirectly essential to the construction and operation of planes, ships, tanks, guns, munitions and other war materiel. This production for war presents many problems not ordinarily encountered in normal peace-time operations. The REILLY laboratories and research department are at your service in the solution of any such problems.

REILLY TAR & CHEMICAL CORPORATION

Merchants Bank Bldg., Indianapolis, Ind.

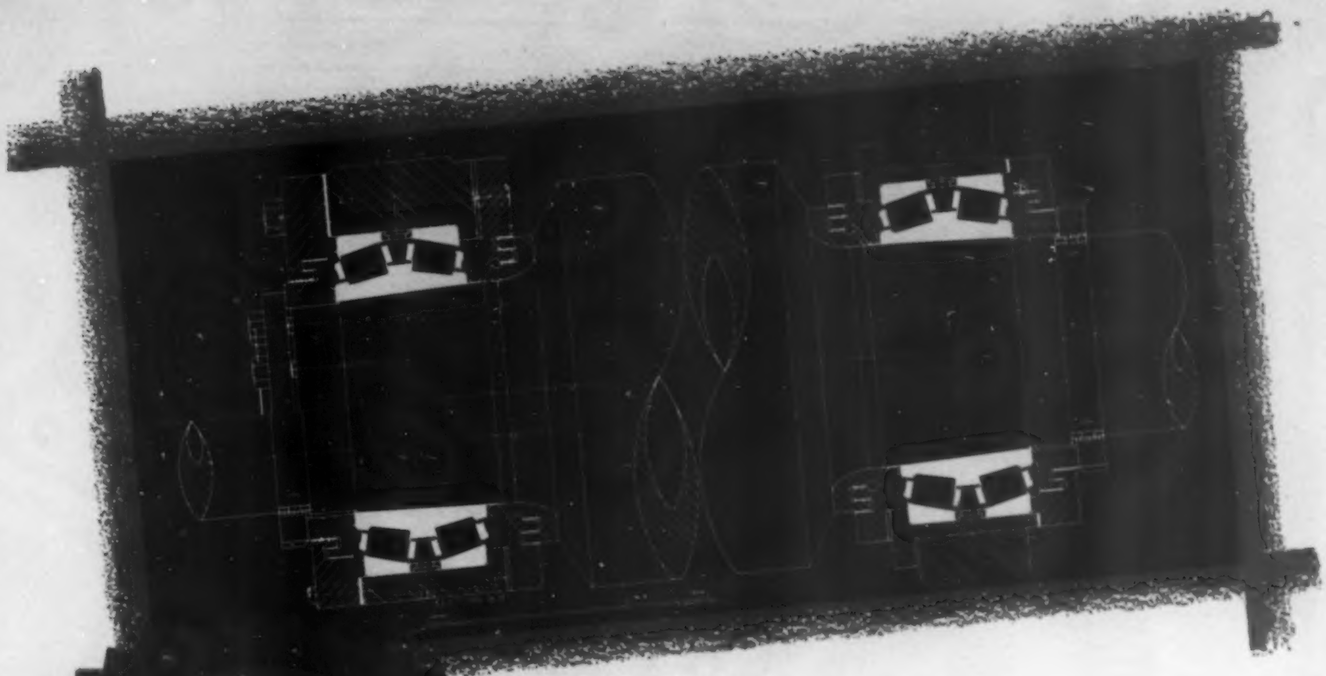
500 Fifth Avenue, New York
2513 S. Damen Avenue, Chicago
St. Louis Park, Minneapolis, Minn.

17 Plants to Serve the Nation

Reilly
COAL TAR PRODUCTS

Reilly

INDUR PLASTICS



Timken Bearing application suitable for use on the roll necks of mills designed to roll plastics materials.

Increase the capacity of your plastics machines for Victory; put more Timken Bearings in them. Redesign now—then you'll also be ready for post-war conditions, be what they may.

The One Test For Every Decision— Will It Help To Win The War?

Timken Tapered Roller Bearings will improve the performance of all kinds of machines used in plastics production, including mixers, mills, calenders, extrusion machines, preforming presses, grinders, lathes, drills, tumblers, abrasive cut-off machines, abrasive forming machines and stamping presses.

A few Timken Bearings are better than none in any machine, but to get the utmost efficiency and economy which these bearings are capable of giving, you should have them at every suitable bearing point. Then your equipment will be fully protected against friction; wear; radial, thrust and combined loads; and misalignment of moving parts. Thus, it will be faster, more accurate and more enduring.

Machine manufacturers whose engineers make maximum use of Timken Bearings are fortunate, for they are getting *better* machines and *better selling* machines; because thousands of machine buyers rely on the trade-mark "TIMKEN" as a sure guide to superior performance and quality.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; and Timken Rock Bits.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

"All There Is In Bearings"

★

Change in Firm Name

★

Sav-way Tool and Machining Co.

BECOMES

Sav-way INDUSTRIES

In the past this company has been known as Sav-way Tool and Machining Co., engaged in the manufacture of precision tank and aircraft parts . . . a line of gauges . . . and internal grinders.

Today Sav-way is composed of six major divisions:

End Mill	*Plastic*
Gauge	*Precision Production*
Internal Grinder	*Specialty Engineering*

With this change of name and expansion in activities, we announce the opening of our new general offices and main plant at 4875 East Eight Mile.

In addition, two other plants have recently been purchased and a fourth is now in the course of construction. These four plants, together with our physical and chemical laboratory, have been newly equipped with the latest and most efficient machinery to help meet present and postwar needs.

"It will be done" is the significant slogan adopted by the young and aggressive personnel of:

Sav-way INDUSTRIES

4875 EAST EIGHT MILE

DETROIT, MICHIGAN

Representatives throughout U. S. A. and Canada

★

Plastic tubes for Toothpaste!

CELLULOSE ACETATE SOLVES THE TOUGH TUBE-PACKAGING PROBLEM

THREAT TO MANY A PRODUCER of toothpaste, shaving cream and pharmaceuticals: the increasingly serious war-shortage of metal tubes. To have no tubes would mean radical changes in packaging, perhaps even in formulae. Could a new tube material be devised? And, equally important, how soon? Ideal answer that also points significantly to the future . . . these *flexible* plastic tubes based on Hercules acetate.

WHAT DO PLASTIC TUBES LOOK LIKE? They can be opaque and printed, identical with metal tubes . . . or *transparent* wherever appearance of the product is a sales advantage.

ARE THEY TOUGH? They are tougher. And lighter. And more resilient. And, of course, there's no trade-in requirement.

THUS, IN A NEW FORM—thin, extruded tubing—the unique combination of advantages in acetate plastic solves a baffling problem. If *you* are looking for a plastic that combines toughness and light-weight . . . clarity and beauty . . . flexibility and economy . . . resistance to acids, alcohols, chemicals and oils . . . we would like to send you information about cellulose acetate, based on our knowledge as one of the nation's leading producers of the cellulose derivatives from which plastics are made. Please address Department MP-13.

Tubes made by Celluplastic Corp., of Celanese Celluloid Corporation's Lumarith.

HERCULES

CELLULOSE ACETATE

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TOUGH • FLEXIBLE • STABLE
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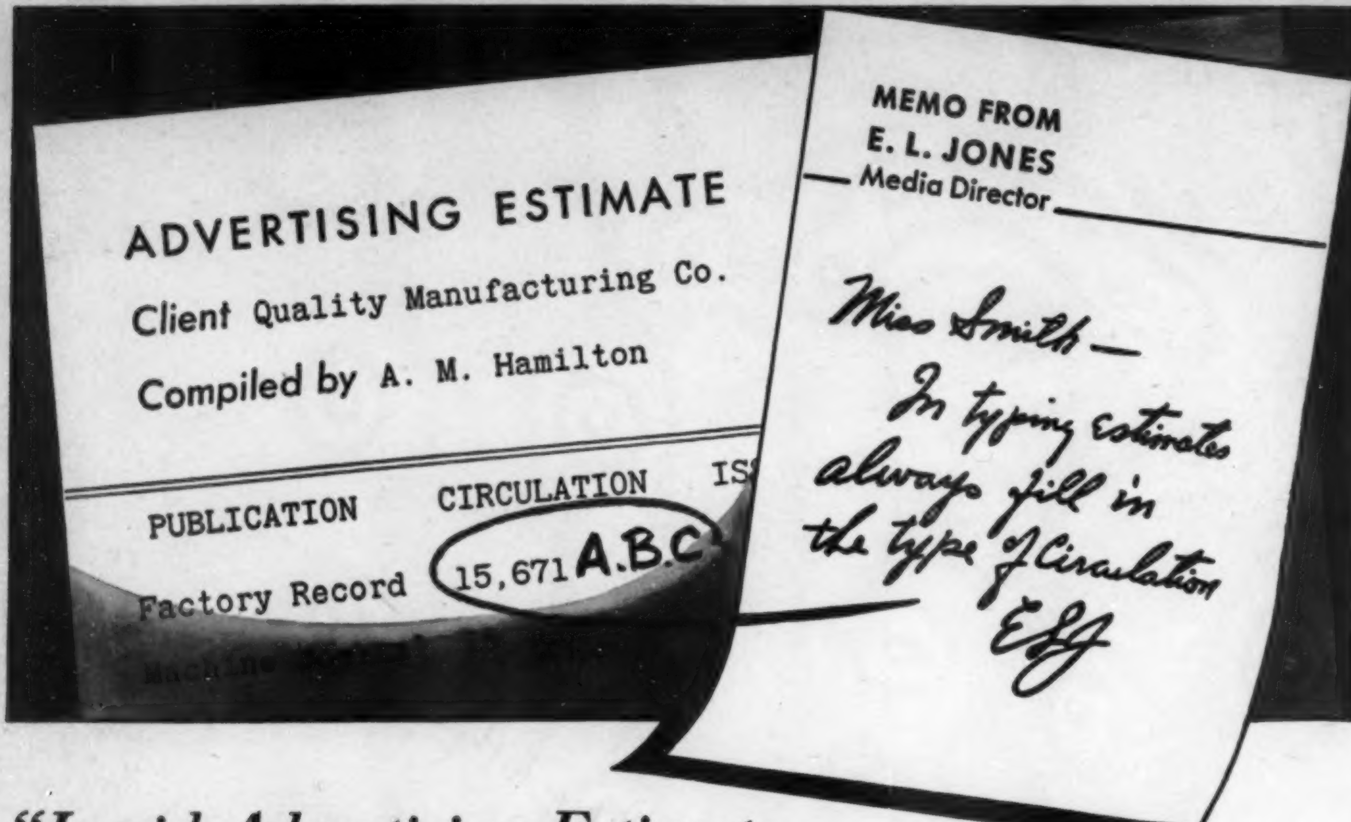

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MODERN PLASTICS

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Manufacturers of:

HYDRAULIC PLASTIC PRESSES
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PLASTICS will keep the world moving faster in the New Age beyond the War. That is a definite prophecy, based on developments now taking place in the plastic fabrication for industries related to war production as well as for domestic manufacture. In fact, Plastics loom as one, if not the greatest of the Industrial Post War Giants. The Rodgers Hydraulic Plastic Press, available again when peace comes, is an acknowledged leader in this field of tremendous potentialities. ★ ***If it's a Rodgers, it's the best in Hydraulics.*** ★ Rodgers Hydraulic, Inc., St. Louis Park, Minneapolis, Minn.

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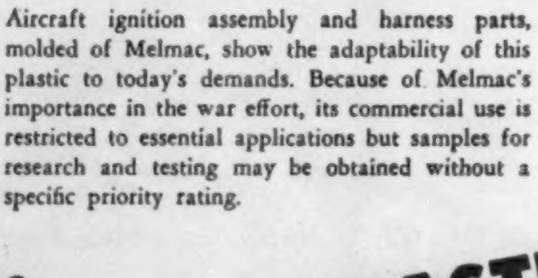
If you are seeking a new insulating material it will pay you to investigate Melmac*—the new, tough, thermosetting plastic—that offers an unusual combination of electrical and physical properties to meet new wartime needs.

For example, Melmac #592 (Mineral filled) has a dielectric strength of 430 Volts/Mil; arc resistance of (ASTM) average: 135 sec.; high heat resistance, and excellent dimensional stability in a wide temperature range.

Electrical parts and housings are being produced with speed and efficiency by conventional molding methods. Screw inserts and contact points are integrally incorporated in the molding operation—eliminating extra steps and speeding assemblies.

Investigate this new material for your dielectric needs. Several types are available to meet various technical and service requirements. Your inquiry about adapting Melmac for *your* needs will receive our prompt attention.

AMERICAN CYANAMID COMPANY
PLASTICS DIVISION
30 ROCKEFELLER PLAZA, NEW YORK, N. Y.



Aircraft ignition assembly and harness parts, molded of Melmac, show the adaptability of this plastic to today's demands. Because of Melmac's importance in the war effort, its commercial use is restricted to essential applications but samples for research and testing may be obtained without a specific priority rating.

BEETLE • MELMAC CYANAMID PLASTICS

MODERN PLASTICS

JANUARY 1943 VOLUME 20 NUMBER 5

The first year of war—and the next

THIRTEEN months ago the United States was viciously attacked by a Judas-like Japan. Thirteen months ago American industry was still turning out the radios, the automobiles, the typewriters, the refrigerators, the washing machines and all of the other many labor-saving devices and civilian products which went into a standard of living that was the envy of the entire world.

Thirteen months ago the plastics industry was still busily engaged in turning out parts for all of these things; and while the nearness of war was sensed, it came with such incredible swiftness and treachery as to make it seem like a nightmarish fantasy. But no fantasy was this war, nor no war of nerves. Grim, fast-moving and real, the series of reverses in the Pacific shocked all American industry out of its peacetime production into production of weapons and matériel with which to defeat our enemies.

The high-speed industrial machines which had been turning out creature comforts suddenly slammed on the brakes, redesigned and retooled for war and began gathering momentum again, this time to produce for war.

In 1942 American industry produced approximately 49,000 planes, 32,000 tanks and self-propelled artillery, 17,000 anti-aircraft guns larger than 20 mm. and 8,200,000 tons of merchant shipping. In all of these, the plastics industry had some part; and production of plastic items for civilian use has been steadily lopped off until in a very short while there will be none at all.

The plastics industry as a whole is steadily increasing its participation in the war production program; and if the rate of increase continues at the present pace, it appears that by the end of 1943 the shortage of molding compound rather than the lack of sufficient press capacity will be the factor preventing greater use of plastics for war applications. For example, during the third calendar quarter of 1942 (July 1–September 30, 1942) 43.6 percent of all compression molding was on work carrying ratings of A-1-k or higher. This is an indication of an increasing use of plastics in war, because during the month of June only 32.9 percent of the compression molding branch of the industry was working on ratings of A-1-k or higher; while during the first quarter of the year (January 1–March 31, 1942) only 16.7 percent of the compression molding capacity was being used for applications carrying so high a rating. Compression molding of phenolic material for war hit an all-time peak during the third calendar quarter of 1942, when 70.7 percent of the molding compound used went into products carrying a rating of A-1-k or higher.

Just as impressive a picture is presented in the extrusion molding end of the industry, with 51.6 percent of the output going into ratings of A-1-k or higher during the calendar quarter, July 1–September 30, 1942. This shows a decided increase over the 39.9 percent so allocated during the month of June and the 27.4 percent going into war applications in the first calendar quarter, January 1–March 31, 1942.

Injection molding has not caught hold so well in the essential brackets. In the first quarter of the year only 11 percent of the thermoplastic materials used in injection molding went into work bearing ratings of A-1-k or higher. During the month of June this increased to 22.4 percent, and jumped during the third calendar quarter to 36.6 percent.

However, there was still a large percentage of unrated orders using thermoplastics. This percentage dropped from 73.5 percent during the first calendar quarter of 1942 to 46.7 percent during the third calendar quarter, but the usage of materials for non-essential end products appeared too large.

In the cold molding field, 64 percent of the industry is now occupied with work carrying ratings of A-1-k or higher, having jumped from 43.6 percent in the calendar quarter, January 1–March 31, 1942.

Plastics applications for war purposes

The year in plastics has seen an ever growing increase in applications for war purposes. One of the major places allotted to plastics is in the field of aeronautics. Transparent sheeting for enclosures of airplanes give the pilot and the crew a wide range of vision, plus protection from the biting air and pressure at high altitudes. The teardrop antenna housing played its part when General Jimmy Doolittle winged over Tokio. Contact among members of the squadron was kept only through this antenna, set unobtrusively on top of the plane.

High-strength pilot seats of canvas fabric impregnated with phenolic and laminated in special molds have represented a major change in design and a contribution of real importance to the comfort and physical wellbeing of pilots.

Machine gun ammunition rollers, fluorescent navigation instrument panels, and parachute flare bases are other airplane equipment items made of plastics.

Indeed, the plastics industry has even contributed the planes themselves, made from plastic plywood. Up until a few short months ago, most of these were training planes; but in Canada the DeHaviland company, builders of famous fighting planes, are now turning out a plastic-plywood two-engine bomber which receives the most glowing reports from Air Intelligence officers. Carrying bomb loads described as "surprisingly formidable," a force of these little planes has outdistanced the fastest German fighters.

Quartermaster Corps items have been naturals for conversions to plastics. Durability, lightness in weight and non-reflecting surfaces are factors of prime importance in soldiers' equipment. Bugles, whistles and bayonet scabbards are now being molded of plastic materials. The buttons on the soldier's uniform, the tent under which he sleeps, the canteen from which he drinks, the water bag from which whole groups of soldiers get sterilized water—all these are now being done in plastics and are being done better than they were in the

* All tables in this survey are abridged from charts prepared by: Conservation Section, Industry & Facilities Branch, Division of Statistics, War Production Board. Compiled from data reported on Form WPB-1251, Plastic Molding Processes: Manufacturers' Report of Facilities and Their Utilisation, submitted by manufacturers of plastic parts.

To the Editor, Modern Plastics:

The year 1942 was one of substantial change for most manufacturers and this was particularly true in the plastics industry. Requirements for military, naval and aircraft use greatly increased. Scarcity of certain materials diminished production for civilian use. At the close of the year only a limited amount of plastics are available for other than war and the most essential civilian uses.

The outstanding effort of material manufacturers during the past year has been devoted to the development and manufacture of plastics needed for war purposes. This work has involved contact with practically every department of the Army and Navy. Counsel and advice has been supplied on the suitability of different plastics for a variety of uses. Innumerable experiments on existing and modified materials have been made in an effort to meet certain critical uses. In many instances new equipment has been designed and production capacities have been increased to meet the enlarged demand for war purposes.

A natural result from all of this development work has been a tremendous increase in the tonnage of plastics now being utilized in the war effort. The trend in requirements continues upward. The amount of research and development work now carried on for war uses is at its highest point. Practically the entire time of the various plastic research units of the country is now devoted to the war needs.

Much of the work being done is directed toward the utilization of plastics because their inherent qualities make them superior to other available materials. A second type of development work covers the utilization of plastics as suitable substitutes for other materials which are critically short. All of this work has resulted in a tremendous number of new applications for plastic materials and practically every type of plastic now being produced is entering importantly into the war effort.

Early in the year Government authorities called the attention of the Plastics Materials Manufacturers' Association to the great deficiency in available physical data on the various types of materials now produced. An immediate effort was undertaken to provide more complete data. A Technical Committee consisting of Mr. J. H. Adams, Chairman, Bakelite Corporation; Mr. L. L. Beck, Catalin Corporation; Mr. H. W. Paine, E. I. du Pont de Nemours & Company; Dr. H. K. Nason, Monsanto Chemical Company; Dr. M. H. Bigelow, Plaskon Company; Dr. W. F. Bartoe, Rohm & Haas Company; and Mr. L. W. A. Meyer, Tennessee Eastman Corporation has been working diligently on the problem. As a result of their efforts, all existing data on the various types of plastics were accumulated and published in a preliminary issue of a booklet during the summer. Existing deficiencies were recorded and a definite campaign was instituted to obtain as much as possible of the deficient data. Marked progress has been made and it is expected that shortly after the first of the year the Plastics Materials Manufacturers' Association will publish a new booklet which, it is believed, will contain the most comprehensive and complete physical data on plastics that has yet been assembled in any single volume. This booklet will be made available to Government agencies and all others in the industry who have occasion to utilize this type of technical data.

Several members of the Plastics Materials Manufacturers' Association maintained close contact with the War Production Board through membership on the Organic Plastics and Resins Manufacturers Industry Advisory, and the Vinyl Resins Producers Industry Advisory committees. Supplementing this work, the Defense and Public Relations Committee, consisting of L. M. Rossi, Chairman, J. C. Brooks, E. C. B. Kirsopp and A. E. Pitcher has been in frequent contact with the various branches of the Government in connection with a variety of plastic problems.

While the material manufacturers are naturally thinking of the postwar period, it is impossible to do any extensive planning because practically the entire effort of all plastics manufacturers is now devoted to war needs and little or no time is available for future planning.

Although not much can be done in preparing for the postwar period under present conditions, the material manufacturers are looking to the future with enthusiasm, optimism and confidence. It is expected that the rapid strides made by the plastics industry in the last few years will continue in the postwar period at an equal or accelerated rate. Of the innumerable new uses developed for plastics in the various branches of the Army and Navy, it is recognized that some will disappear when there is a free market on all types of materials but it is also confidently expected that many will be retained and become permanent outlets.

Much has been learned in projecting the use of plastics in new applications and a great deal of information has been assembled on the strength and weakness of these materials. As an indirect result of the vast amount of testing and development work carried on in connection with war needs, it is not improbable that some entirely new plastics with new and different properties will become available in the postwar period. It is certain that several of the more recently developed plastics now in the early stages of development will have a large expansion after the war is over.

Plastics will continue to play an increasingly important part in the war effort for the duration. Material manufacturers are confident they will continue to play a conspicuous and growing part in the industrial world following the establishment of peace. The industry has gained a momentum and impetus which should and will carry it into substantially larger and more extensive fields of operation in the postwar period.

December 14, 1942

A. E. Pitcher
President, Plastics Materials Manufacturers' Association

materials originally used. Plastic molders are making thousands of razors, shaving brushes, tooth brushes and all of the personal toilet items that help keep a soldier clean and keep up his morale.

The Signal Corps could hardly get along adequately in modern warfare without plastics equipment. Antennae, hand generators, dynamotors, batteries, microphones, insulator beads, head sets, telephone units and literally scores of other applications have been done better in plastics than in any other material. The insulating qualities of certain vinyl resins and polystyrene are, of course, unsurpassed. The famous "Handy-Talkie" radio depends upon several plastic parts for its proper functioning.

The gallant story of Corregidor and Bataan and the men who were "expendable" could never have been told were it not for the little plastic-plywood boats—those P.T. boats

that raised havoc with Jap landing forces and gave the other Allied Forces precious days in which they could prepare themselves against assault. The strength of plastic-plywood construction in the P.T. boats has been attested by the deeds which they have performed.

Less sensational but of equal importance has been the rôle of the "elastic" plastics in insulation aboard U. S. Navy vessels. The development of suitable plastic materials for this application, superior in quality to other insulation, and dependent upon no foreign source for its raw material, represents a real advance in technique. Navy gage cases made from plastics, thousands and thousands of them, are doing a better job than the old brass cases.

In Naval Ordnance, fuze loaders, fuze plugs, fuze covers, booster tubes, signal grenades, signal pistols, instrument disks and control parts, fire control panels, machine gun handle grips and ammunition handle parts for loading operations have proved to be outstanding examples of the plastics industry's part in producing for war.

Gas mask parts and protective coatings made of plastics have proved to be of major importance in the Chemical Warfare Service. The adoption of cellulose acetate for various parts of the gas mask resulted in a weight saving of more than 70 percent, and the efficiency of vinyl coverings and other protective coatings for contamination garments has been amply proved to the experts of the Chemical Warfare Service.

Perhaps the most outstanding job done by the industry during 1942 was the successful molding of the trench mortar fuze. Originally made from aluminum, the item was converted by Army Ordnance to a molded phenolic. Molders had to maintain extremely close tolerances and the finished pieces undergo a very rigid inspection. Through cooperative effort of many in the industry, the various "bugs" in the job have been ironed out, and now thousands of these fuzes are being turned out daily in several plants throughout the country. Production speed, once the job was solved, is amazing.

Certain synthetic plastic protective coatings have been successfully utilized to prevent rusting and corrosion of low

Compression Molding Process

Percent of Total Pounds of Compounds Consumed in the Manufacture of Plastic Parts by Orders with Priority Ratings, for Specified Periods

Period covered and type of compound	*Percent A-1-k or higher*	*Percent A-2 through A-9*	*Percent A-10*	*Percent B*	*Percent all other orders*
Jan. 1–Mar. 31, 1942 (monthly average):					
Total all compounds	*16.7*	*3.8*	*6.8*	*14.0*	*56.8*
Phenolics	31.3	6.5	11.3	19.1	28.6
Ureas	8.1	3.7	9.7	43.6	33.2
Shellac and natural gum	.1	.4	.1	.1	99.3
Record compounds	...	..	...	..	100.0
Impregnated cloth and fiber plastic sheeting	...	..	100.0	..	...
Thermosetting	7.0	3.2	5.0	.6	84.2
Vitrolac	...	..	...	..	100.0
Hard rubber	100.0	..	...	..	...
Tenite	1.8	47.5	...	..	50.7
All other	29.8	6.7	14.3	25.3	23.9
June 1–30, 1942:					
Total all compounds	*32.9*	*4.2*	*4.8*	*8.4*	*48.6*
Phenolics	57.6	6.7	6.8	7.6	19.6
Ureas	8.5	3.4	8.8	39.7	38.3
Shellac and natural gum	.2	.5	.2	.1	99.0
Record compounds	...	..	...	..	100.0
Impregnated cloth and fiber plastic sheeting	7.8	..	92.2	..	...
Thermosetting	35.9	3.3	2.4	..	58.4
Vitrolac	...	..	...	..	100.0
Hard rubber	100.0	..	...	..	...
Tenite	93.2	4.3	...	..	2.5
All other	33.6	3.5	27.5	19.7	15.7
July 1–Sept. 30, 1942 (monthly average):					
Total all compounds	*43.6*	*4.5*	*3.3*	*6.3*	*40.8*
Phenolics	70.7	6.1	4.5	3.3	13.1
Ureas	16.5	7.2	4.6	34.6	36.0
Shellac and natural resin	.3	.7	.2	.1	98.7
Record compounds	...	..	...	..	100.0
Impregnated cloth and fiber plastic sheeting	96.9	..	3.1	..	...
Thermosetting	48.2	2.9	3.7	..	45.2
Vitrolac	...	..	...	..	100.0
Hard rubber	100.0	..	...	..	...
Tenite	100.0	..	...	..	...
All other	55.5	12.4	7.2	23.4	1.5

carbon steels. Extensive experiments have been and are being conducted in the use of plastics for barrage balloons. Binocular coverings, formerly made of rubber, are now successfully handled in plastic materials.

The year ahead

These are all jobs of which the industry is proud, and for which the individual molders who have accomplished them deserve to be complimented. But in war things move fast and changes come rapidly. What is good today is poor tomorrow, and what has not been thought of today is suddenly the big job of tomorrow. It is always difficult to try to peer into the future. It is even more difficult to peer into the future during the war years because applications and trends are kept secret and predictions are hushed for fear they might aid the enemy. Thus, only general rules can be laid down which will illustrate the trend of thinking in the purchasing and planning offices of the armed services and in the other Government departments as to the future rôle of plastics.

What does the part do? First and foremost, it is important that the industry acquaint itself with the functions of matériel which it is attempting or planning to manufacture. Unfortunately, during the early period of the rearmament program of this country, some of the master planners in Washington thought that plastics would be a panacea for all materials shortages. Whenever a job came up that could not be done satisfactorily in another material or would use too much "critical" material, they would immediately throw it into the lap of the plastics industry.

The result of this muddle-headed policy was almost fatal to the industry. Plastics got a bad name. Whenever a job came up for which plastics were suggested, the suggestion would be squelched by someone else in the conference who had had a previous unfortunate experience in attempting to put plastics to a use for which it should never have been tried.

It has been a long, tough and hard struggle to educate those who were once bitten, and now are twice shy, to the fact that plastics can play an important part in winning the war. Those who have been so educated complain it is almost equally as difficult to educate the plastics industry to determine the functions of matériel before they try to make it. As an example, one molder submitted to the Ordnance Department of the War Department a shell fuze, a part of which was made from polystyrene. Obviously, what had happened was that the molder had seen the fuze made completely of metal in some exhibit of Ordnance matériel, had decided that it was not a particularly difficult molding job, and had proceeded to mold it without finding out any more about it. He then sent the fuze to Washington, seeking an order for its manufacture. It was equally obvious that he had not bothered to find out what functions and what performance standards the part had to meet.

INJECTION MOLDING PROCESS

Percent of Total Pounds of Compounds Consumed in the Manufacture of Plastic Parts by Orders with Priority Ratings, for Specified Periods

Period covered and type of compound	*Percent A-1-k or higher*	*Percent A-2 through A-9*	*Percent A-10*	*Percent B*	*Percent all other orders*
Jan. 1–Mar. 31, 1942, (monthly average):					
Total all compounds	*11.0*	*3.9*	*4.2*	*7.4*	*73.5*
Cellulose acetate	6.7	2.6	3.9	8.8	78.0
Cellulose acetate butyrate	17.2	11.8	7.0	2.8	61.2
Polystyrene	17.3	3.6	4.0	5.5	69.6
Methyl methacrylate	19.6	1.6	2.3	2.4	74.1
Ethyl cellulose	1.6	8.3	..	..	..
Vinylite	6.9	..	.3	.1	92.7
Vinylidene chloride	25.7	9.9	9.9	..	54.5
All other	52.7	1.6	9.4	26.0	10.3
June 1–30, 1942:					
Total all compounds	*22.4*	*3.8*	*4.3*	*6.4*	*63.1*
Cellulose acetate	12.1	2.0	4.2	7.4	73.1
Cellulose acetate butyrate	50.4	10.2	5.5	3.2	30.7
Polystyrene	31.3	4.1	4.4	2.0	57.7
Methyl methacrylate	33.5	.6	2.5	6.8	54.4
Ethyl cellulose	30.5	30.5	1.9	..	37.1
Vinylite	12.4	.4	.4	..	86.8
Vinylidene chloride	50.5	16.5	16.5	..	16.5
All other	70.4	.7	5.5	22.7	.7
July 1–Sept. 30, 1942 (monthly average):					
Total all compounds	*36.6*	*4.9*	*5.1*	*6.7*	*46.7*
Cellulose acetate	20.9	4.4	5.2	9.8	59.7
Cellulose acetate butyrate	64.0	8.0	5.9	2.3	19.8
Polystyrene	49.8	6.1	4.9	3.9	35.3
Methyl methacrylate	48.0	.8	3.6	.8	46.8
Ethyl cellulose	49.8	3.4	5.3	..	41.5
Vinylite	41.4	.5	.2	.1	57.8
Vinylidene chloride	50.1	14.1	25.3	..	10.5
All other	95.9	.1	3.0	.3	.7

In the first place, this fuze leaves the barrel of the field piece at ten thousand revolutions per minute. It has to take a terrific set-back in the recoil of the gun. It has to stand a temperature of $-70°$ to $+140°$ F. The muzzle velocity of the projectile in which the fuze is contained is astounding, and the molder should not have attempted to do the job in a thermoplastic, which could not possibly stand up under these conditions. If he had consulted the District Engineer in the Ordnance Department in his district, he would have saved himself and the Ordnance Department time and trouble; and, what is even more important, he would have saved the plastics industry another black eye. As it happened, the persons who received this item in Ordnance were ready to condemn all plastics for any Ordnance equipment as a result of

EXTRUSION MOLDING PROCESS

Percent of Total Pounds of Compounds Consumed in the Manufacture of Plastic Parts by Orders with Priority Ratings, for Specified Periods

Period covered and type of compound	*Percent A-1-k or higher*	*Percent A-2 through A-9*	*Percent A-10*	*Percent B*	*Percent all other orders*
Jan. 1–Mar. 31, 1942 (monthly average):					
Total all compounds	*27.4*	*0.6*	*1.0*	*16.9*	*54.1*
Cellulose acetate	13.6	.2	5.7	4.3	76.2
Cellulose acetate butyrate	17.7	3.1	4.3	.2	74.7
Polystyrene	81.9	8.9	..	..	9.2
Methyl methacrylate	5.4	..	..	..	94.6
Ethyl cellulose	7.7	1.3	..	..	91.0
Vinylite	82.9	.1	.9	..	16.1
Vinylidene chloride	11.0	4.4	4.4	..	80.2
Casein	...	..	..	40.6	59.4
Koroseal	100.0	..	..	..	...
Cellulose nitro	64.2	..	..	..	35.8
Cellulose nitrate	10.2	2.7	.1	..	86.0
Vinylidene chloride (saran)	1.7	.3	.2	..	97.8
Divinyl butyral, polyvinyl butyral and polybutene	100.0	..	..	..	...
All other	13.5	..	..	..	86.5
June 1–30, 1942:					
Total all compounds	*39.9*	*2.8*	*1.7*	*12.2*	*43.4*
Cellulose acetate	20.5	.2	2.9	7.3	69.1
Cellulose acetate butyrate	31.3	5.4	9.4	.1	53.8
Polystyrene	89.9	7.4	..	..	2.7
Methyl methacrylate	7.1	..	..	..	92.9
Ethyl cellulose	4.3	9.2	.6	20.7	65.2
Vinylite	90.5	.1	.6	..	8.8
Vinylidene chloride	47.2	15.8	15.8	..	21.2
Casein	...	..	..	36.9	63.1
Koroseal	100.0	..	..	..	...
Cellulose nitro	7.1	13.4	..	..	79.5
Cellulose nitrate	4.1	22.3	.1	.3	73.2
Vinylidene chloride (saran)	6.6	3.4	13.2	..	76.8
Divinyl butyral, polyvinyl butyral and polybutene	89.0	..	..	..	11.0
All other	77.7	4.9	1.4	..	16.0
July 1–Sept. 30, 1942 (monthly average):					
Total all compounds	*51.6*	*3.7*	*7.2*	*10.4*	*27.2*
Cellulose acetate	19.0	.4	4.1	7.9	68.6
Cellulose acetate butyrate	52.0	7.1	8.4	.5	32.0
Polystyrene	84.3	4.5	4.5	..	6.7
Methyl methacrylate	24.8	..	..	67.4	7.8
Ethyl cellulose	19.8	1.4	1.5	..	77.3
Vinylite	99.0	.5	.1	.3	.1
Vinylidene chloride	54.1	28.7	4.9	..	12.3
Casein	...	..	..	38.5	61.5
Koroseal	100.0	..	..	..	...
Cellulose nitro	20.6	27.3	5.0	..	47.1
Cellulose nitrate	...	..	..	..	100.0
Vinylidene chloride (saran)	20.0	40.0	20.0	20.0	...
Divinyl butyral, polyvinyl butyral and polybutene	31.0	..	67.4	..	1.6
All other	95.5	3.0	..	..	1.5

To the Editor, Modern Plastics:

January 1943 finds the plastics industry operating on an all-out war basis. Generally the industry was prepared to handle the load which was thrust upon it when the call to colors came following Pearl Harbor. As an experienced team, the molders, fabricators, and material suppliers rolled up their sleeves and set about converting for war production.

Before December 7, it will be recalled, OPM was the Government agency which had jurisdiction over the country's industrial production. With isolationists then stumping the country there was no unanimous conception of what the armament program should involve. Industries and interests vied for preferential Government treatment on supplies of materials. With lightning swiftness following Pearl Harbor, all minds were focused on one goal. OPM was liquidated shortly after the New Year. On January 24, 1942, the War Production Board was created.

The first year of World War II, as might be expected, has seen the plastics industry along with others adjusting itself to wartime conditions. Two things have characterised the period: first, switching from peacetime output to the production of military equipment and allied component parts; secondly, adjusting to necessary government emergency material and price regulations as required by OPA, WPB and other agencies.

The change-over to war materiel production has been accomplished in remarkable time. In June of 1942, only 65 per cent of all molding was for war purposes. As the year ended, this percentage had increased to approximately 83 percent and was still climbing. Additional production capacity is still available in the industry for handling high priority business which is indicated by recently compiled figures which show the average molding plant to be working 111.4 hours a week.

While considerable engineering had been done on many of the applications and while others fell into conventional patterns, the fact remains the industry's production and design engineers had to crack some tough technical nuts. The soldiers' helmet liner is an example. Here was a molded laminated article required in tremendous quantities necessitating practically a new manufacturing technique. Not less than six firms are now producing them on schedule.

Probably no more difficult sizable job was ever handed the industry than the now famous trench-mortar fuze. It presented every known problem in transfer molding. Moreover, close tolerances were specified, multiple gauging was required and the part had transverse holes as well as threaded sections. Several heads ached before the kinks were ironed out of this assignment. Today the Ordnance Department is receiving these fuses in quantity and on schedule. Where plants have had to undertake an entirely new type of production, they have done so, as demonstrated by the several which are now forming methacrylate and other thermoplastic sheets for transparent combat aircraft enclosures. In the main, the tremendous plastics production assignment which the industry has undertaken has been handled between the contracting firms and the Government or prime contractors.

In some cases where specification questions have arisen or where a problem of common interest has developed, SPI, working through regular or special committees, has cooperated in seeking a solution. The U. S. Naval Observatory enlisted a SPI committee to work on developing an appropriate plastic covering for fire control instruments and to investigate the possibility of molding a binocular body. The first problem was solved. A covering specification has been written. Experimental work on the molded binocular body is going forward in an encouraging manner. A SPI committee working with the Quartermaster Corps assisted in preparing specifications to cover the plastics for all types of uniform buttons. The U. S. Army Signal Corps have called upon SPI to collaborate with the WPB "War Committee on Radio" in undertaking the preparation of specifications and design criteria on plastics for communications. The activity is now in its initial stages.

Still other committees are working with the Naval Aircraft Factory, the Army-Naval Civil Committee on Aeronautics and other branches of the Government. Without the splendid unselfish cooperation from companies in the industry, it would have been impossible to accomplish the results which have been achieved.

If any problem confronts the industry today, it is that of obtaining tools and dies. While there are a great number of companies who specialize in this work located in various sections of the United States, nearly all these are at or near capacity.

Keeping abreast of and adjusting to the multitudinous orders of the National War Agencies has kept the accounting, legal, and executive departments of most plastics companies occupied, if not entertained. The paper work and, as someone said, the wastepaper work, have kept both man and basket busy.

Early in the year, the industry only had the WPB General Preference Order regulating thermosetting materials to reckon with. As the year progressed thermoplastic materials and plastic machinery were placed under order. Since many of the regulations were amended or interpreted from time to time, it was something of a problem to keep abreast of all changes. The materials allocation plans which are now being promulgated are well received. They should clarify and it is hoped iron out the problems of the plastics materials allocation system which existed before their inauguration.

During the year, SPI sponsored meetings in various sections of the country to provide a chance for WPB officials to address representatives from the industry. In this manner, many points in existing orders were clarified and "on the spot" interpretations settled others. The cooperation of WPB in sending officials to these meetings made them successful.

The sectional industry meetings which OPA held in Chicago and New York in September assisted in familiarizing the industry with the price control measures that affect plastics.

At the request of the Canadian Plastics Industry, we met with representatives of the Canadian Industry in Toronto early in the year to counsel them on the operation of the industry in the United States under war conditions.

1942 was packed and crammed with activities which arose as a result of the war. The brain power of the industry, as I view it, has been devoting every ounce of its mental ingenuity to improving, creating, or devising more plastics or plastics production for war purposes. Inevitably, the advances for processing them will have peacetime uses. But postwar planning is in the deferred file.

Now that we have our war machine operating under a full head of steam, we must keep it running in high. It is a delicate piece of equipment with millions of operating parts and an infinite number of controls. Operating it is a full-time assignment which requires the energy of all the available trained skilled talent we have.

We can't afford to take these minds off their work. After all, they are handling their biggest job.

December 14, 1942

Ronald Kinnear

Ronald Kinnear
President, Society of the Plastics Industry

How plastics have gone to war

by F. H. CARMAN*

THE war requirements for the resins change so rapidly from month to month that it is believed desirable to keep the industry informed on the current position so that fabricators and users of plastic materials will be familiar with the trends and, it is hoped, more able to determine materials that will be available for any given product.

There are many things that affect the availability of plastics for the essential war products. There is a surprisingly wide range of chemical raw materials used in the manufacture of resins. Some of the most important of these are alcohol, acetic acid, formaldehyde, butyraldehyde, ethylene dichloride, benzol, phenol, cresols, acetone, acetylene, urea, various inorganic acids, cotton linters and wood pulp. This list is again supplemented with many plasticizers required for plastics and oftentimes the plasticizers become a determining factor in the availability of the final plastic rather than the resin components. Another determining factor is the equipment required to manufacture the various items.

One of the most important families of plastics is that class commonly called the *phenolic resins*. Aircraft, tanks, battleships, radios or war plants as they are known today cannot be built without phenolic resins. Comparing the situation with peacetime, the demand for molding compounds, brake lining resins and a few of the specialities has diminished while there has been an increase in the plywood adhesives, laminating varnishes and grinding wheel resins.

The total requirements for resins and molding compound for the month of December were in excess of 27,000,000 lb., and an allocation of about 70 percent of this was possible. More phenol was available for December than for many previous months.

The uses of many of the implements of war have been well known, but it is interesting to note the increase during the past year. Studies of this first allocation indicate that 80 percent of the material is going into direct implements of war, 13 percent to indirect and about 7 percent to essential civilian items. Most of the major direct military products being made with phenolic resins are well known to the industry today; these include such products as ship and submarine parts, bomb parts, helmet linings, pulleys, fairleads, ignition parts for aircraft, ships and tanks, medical supplies, uniform buttons, electricial insulation parts of all types, aircraft and naval structural members, heat insulation, plywood adhesive and special coatings for aircraft, ships and military vehicles.

The indirect military products are of vital importance since these items often are necessary for production of the actual war implements. This general class of items is made up of such products as industrial power and light electrical parts, medical supplies, industrial and agricultural equipment, precision tool parts, gears, corrosion resistant parts, heat insulation, abrasive and wheel binder, friction material such as brake linings and clutch facings, bus blocks and gasket binders.

The essential civilian allocation of approximately 7 percent was mainly for closures for food and drug items, health supplies, protective coatings for industrial plants, printing plates, agricultural equipment, textile production parts and automotive maintenance items.

The supply of phenolic resins is dependent today on the tar acids available for this use; manufacturing facilities are believed to be ample as the industry is operating at about 65 percent of capacity. It is anticipated that we can keep the present essential requirements of war products supplied with the necessary material and it is desirable to maintain the present uses.

The next important thermosetting resin is *urea-formaldehyde*. It is estimated that the industry is now operating at about 90 percent capacity for molding material and that 50 percent of this is going to direct war use. A major portion of the war requirements is for adhesive purposes, and additional capacity is available for anticipated growth for plywood and paper binders. The restrictions on phenolic resins will probably cause a decided increase in the urea-formaldehyde resin requirements.

Even though urea-formaldehyde materials are not adaptable to the making of most war implements, because of somewhat less heat resistance and waterproofness as compared with phenolic resins, there have been many direct war applications developed and an increase is anticipated. This material has been adopted for Army overcoat buttons and its use in plywood will, undoubtedly, increase materially in the immediate future.

The *melamine* plastics have certain qualities, such as arc resistance and surface hardness, which render them particularly interesting in special electric insulation items for aircraft and for certain molded parts for both the Army and the Navy. The industry is in a rather precarious position due to the limited capacity for the manufacture of melamine, and this will hamper the rapid expansion of several parts which are on a semi-experimental basis at this time. Certain plant expansions are now being considered to provide a larger supply of this chemical.

The *vinyl resins* have rapidly become a major substitute for rubber in many direct war products and are, therefore, of considerable interest in the industrial field at this time. The best known representatives of this class of resins are the so-called polyvinyl chloride types currently being manufactured in two grades. The highly insoluble type compound, 92 percent or over of vinyl chloride, is now being manufactured in amounts over 3,000,000 lb. per month. This particular production has been gradually increased from a total of about 1,000,000 lb. per month in January of 1942. Approximately 93 percent of the available material is now going into direct military products, a little over 6 percent to indirect military products and less than 1 percent to essential civilian items. Over 60 percent of the direct military uses are insulation and sheathing for shipboard wire and cable. Other major military uses for this material include certain coatings for felt pads, life preserver packs, pilot boots, protective clothing, hospital sheeting, fuel tank lining.

Of the material in the class of under 92 percent vinyl chloride, about 80 percent of the available supply is going to direct military products and 20 percent to the indirect classification. The production of this grade of resin is approximately one-fourth of that of the high vinyl chloride already mentioned. Some of the major uses of this grade of resin are for proofed goods replacing rubber, rigid sheets for navigation computers, instrument dials and gage covers, photographic templets and similar precision instruments. This grade is also being used for hospital sheeting, acid-proof paint and certain food packaging.

It is very difficult to expand the production of this material both because of the raw materials and power needed to provide the acetylene and the equipment required in the manufacturing operations. Because of the high purity standard required for electrical uses, it is necessary to use stainless steel or glass-lined equipment in the production plants and it appears that it would be somewhat simpler to expand rubber manufacturing capacity under present conditions. Through certain other expansions, already under way, it is anticipated that the high molecular weight resin will be expanded by about 60 percent during the middle of this year. It, therefore, appears that the polyvinyl chloride resins will be in a better supply status during the third quarter of 1943.

Remarkable progress has been made by the various fabricators in effecting a saving of rubber through the use of resins derived from vinyl acetate, particularly the polyvinyl butyrals and polyvinyl acetates. It is a little difficult to give figures on the amount of these resins used as actual rubber substitutes. However, in a single month this material used to replace latex for adhesives and rubber in raincoats amounted to 1,400,000 pounds.

There is an acute shortage in the raw material required to make these resins and, for this reason, the most recent allocation

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to this class of products took care of only the most necessary war uses. It is interesting to note that the raw material supply only permitted the existing production facilities for polyvinyl acetate to run at $3^1/_2$ percent of capacity during December. It is anticipated that more of this material will become available during the next several months.

The present uses of polyvinyl butyral resin are entirely for military products and the principal uses might be classified as waterproofed and coated fabrics, laminated safety glass and bullet-proof glass and special gas protective covers. There has been a minor expansion in the production capacity of this resin during the past year, although it is anticipated that further expansion will be very difficult to carry through because of the raw material supply problem and the stainless steel required for processing equipment.

It is desirable to maintain the present uses of the butyral resins, in so far as possible, so that existing fabricators can continue on the products now being made; further conversion of existing plant facilities to process these resins will probably be discouraged.

A small amount of polyvinyl alcohol is currently being produced and because of the larger war demands, the existing equipment is operating at capacity. The major uses are special Chemical Warfare Service items and other applications in direct military products including instruments, lithographic plates, zinc plating and special fiber treatment. New direct war uses of polyvinyl alcohol will probably require additional equipment.

The other important member of the acetal family is polyvinyl formal resin which is currently being used as a special wood impregnating compound and as wire insulation. New plants have been put into operation during 1942, and it is possible there will be another 25 percent increase in capacity during 1943. None of this material is now available for civilian articles.

There has been no major change in the supply picture for the *acrylic resins* over that already reported to the industry. The material will be placed under full allocation, effective in January 1943, and the major portion will continue to be diverted to cast sheet for aircraft noses, turrets, domes, etc. In addition to the aircraft sheet requirements, the material is desirable for leather finishes, molding powders for direct military items, chemical warfare uses, hydraulic oil treatment, fireproofing of special fabrics and optical lenses. The major uses already reported are for methyl methacrylate resins but there is already considerable production on ethyl and butyl methacrylate. These grades are used for direct military items.

It is anticipated that the sheet capacity for manufacture of aircraft parts will be materially increased during 1943 and the forecast is 150 percent, 186 percent, 250 percent, and 285 percent for the first, second, third, and fourth quarters, respectively, of 1943, as compared with the fourth quarter of 1942. Because of the large demands for aircraft sheet, it has been necessary to substitute some of the other available plastics in the less critical assemblies; cellulose acetate and polyvinyl chloride sheet are currently replacing methyl methacrylate in many uses.

There has been no major change in the supply picture for *polystyrene resin* as compared with former industry reports except that it is somewhat more restricted. It is expected that this resin will be put under full allocation and only the most direct war requirements will be satisfied. These restrictions are necessary because of the styrene requirements for the synthetic rubber program and the benzol needed for the manufacture of the styrene monomer. Over 50 percent of the available styrene is now being diverted to synthetic rubber and the balance is going to direct war products in the form of polystyrene. It will be necessary to maintain the use of polystyrene in certain direct war products where its peculiar electrical qualities will not allow substitutions by other and more available resins.

The demand for *cellulose acetate* for use in plastics and film for war products has greatly increased. One of the major changes during the last twelve months has been a switch in raw material wherein the amount of wood pulp now being used for manufacture of this plastic is twelve to sixteen times that amount used in 1941. It is estimated that the molding powder facilities for cellulose acetate are now operated at 80 percent of capacity and the present production is 155 percent of that produced during a corresponding period in 1941. This, undoubtedly, is due to the substitution of plastics for more critical materials and this trend will probably continue to increase as the war program progresses. It is doubtful if the production will be increased to any great extent because of the lack of acetic anhydride which is now sufficiently critical to require complete allocation. There is also a shortage in the supply of plasticizers required.

A considerable amount of cellulose acetate propionate is currently being used for the production of special film and lacquers. The major portion of the material is now going into direct military items including coatings for wire insulation on aircraft, and film for all types of photographic apparatus. The production is now running at approximately 80 percent of capacity with every indication that the war requirements will continue to increase.

The supply of *cellulose acetate butyrate* plastic is sufficient to take care of all demands now being permitted by existing WPB mandatory control orders. The molding powder production facilities during the past year have been operating at capacity and the war uses are increasing gradually. The molding powder is used for such military items as steering wheels for trucks, machine gun handles, bayonet scabbards and grips, gas mask parts, miscellaneous aircraft parts, blackout filter lenses, first aid kits, goggles, flashlights and ammunition box rollers. A definite trend to war products is indicated by the amounts permitted for civilian uses—41 percent of available material in the third quarter, and 30 percent in the fourth quarter. This cellulose plastic is also used for production of special film, largely used for x-ray and aerial photography, and a waterproof coating for prints. A certain amount is used for wire insulation for aircraft construction. Production rate is now approximately double that of the first half of 1942.

Acetate-butyrate is currently used for coating compositions, again for electrical insulation purposes, and for dope in military aircraft where it has been found to be superior to the plastic formerly used. This again emphasizes the gradual trend of the uses to direct military requirements.

Cellulose nitrate or nitrocellulose is one of the oldest plastics in the industry today and is still important, both as a plastic and a surface coating composition. There have been considerable military usages established in both fields. There are now four large producers of this material and an additional six smaller manufacturers producing this plastic for their own consumption. The production of sheet, rod and tube in 1942 is slightly ahead of that in 1941 and is now running almost at capacity. One of the limiting factors on the production of cellulose nitrate in any form is the nitric acid required as one basic raw material. The future supply of this plastic is somewhat in doubt at this time, but it appears that it will not become any more critical than at present. Owing to the slackening in demands for lacquers which were formerly used in the manufacture of many civilian items, such as automobiles and refrigerators, there has been less demand for these coatings.

The supply of *ethyl cellulose* is insufficient to take care of military demands at the present time, and certain of these requirements have been eliminated when the ethyl cellulose could be replaced by other plastics. The material has certain flexibility and freedom from brittleness at low temperature together with good high temperature characteristics, making it valuable for many military uses. It is predicted that in the near future, military needs will seriously exceed the available supply. The shortage is entirely a question of production facilities for making ethyl cellulose and any plant expansion will require sizable amounts of critical materials.

A study is now being made of the available injection molding machine capacity in the industry with a view toward diverting idle equipment to war work rather than building new machines during this critical period. This type of equipment is believed to be the only major class of facilities not converted to war work.

It is estimated that the total yearly production of plastics is about 180,000 tons. This is a very low figure compared with the total production of steel, copper, aluminum, magnesium or the contemplated production of synthetic rubber. The war program, combined with a shortage of many materials, has materially increased the requirements for plastics, both for the uses which have previously been established for plastics, and as substitutes for metals or rubber.

It is hoped that this information will serve to indicate how our economy has shifted from the use of plastics for strictly civilian products to an almost all-out war production early in 1943.

COLD MOLDING (MECHANICAL AND HYDRAULIC) PROCESS

Percent of Total Pounds of Compounds Consumed in the Manufacture of Plastic Parts by Orders with Priority Ratings, for Specified Periods

Period covered and type of compound	*Percent A-1-k or higher*	*Percent A-2 through A-9*	*Percent A-10*	*Percent B*	*Percent all other orders*
Jan. 1–Mar. 31, 1942 (monthly average):					
Total all compounds	*43.6*	*3.8*	*19.3*	*7.2*	*26.1*
Refractory cold molded	51.7	3.9	26.5	13.4	4.5
Non-refractory cold molded	38.1	3.8	15.2	3.9	39.0
Phenolic or cresol resin in non-refractory compound	80.8	1.0	17.7	..	.5
June 1–30, 1942:					
Total all compounds	*66.6*	*5.7*	*14.3*	*1.3*	*12.1*
Refractory cold molded	72.9	6.3	17.0	2.2	1.6
Non-refractory cold molded	62.2	5.6	12.3	.8	19.1
Phenolic or cresol resin in non-refractory compound	77.1	2.3	20.6	..	..
July 1–Sept. 30, 1942 (monthly average):					
Total all compounds	*64.0*	*7.1*	*10.4*	*.3*	*18.2*
Refractory cold molded	88.9	7.2	3.7	.1	.1
Non-refractory cold molded	52.5	7.2	12.8	.5	27.0
Phenolic or cresol resin in non-refractory compound	77.8	2.4	19.8	..	..

this one slip-up. Had it not been for the plastics specialist in the Ordnance Department, this unthinking error could have been a major blow to the entire industry.

Therefore, Rule No. 1 for the plastics industry in getting more of its products used in war matériel is to know the function of the parts to be manufactured before it proceeds.

Selling plastics for the job. The second thing to remember in increasing the use of plastics for war is that there still remains a colossal selling job to be done in convincing procurement officers and engineers that plastics will do a better job than the customary old line of materials which they have been using.

This point is integrally connected with the first. In other words, before there can be any proper type of selling job done, the function of the piece which is to be converted to plastics must be thoroughly understood. To a large extent, the plastics industry is a sub-contracting industry in production for war. Most of the pieces made by the plastics industry to be used in matériel are just a part of the finished product. This makes it difficult to get pieces converted from metal or other material to plastics because the person responsible for final assembly and performance of the finished item may not want it made out of plastics. So there is a twofold job: first, to sell Government procurement officers, and second, the prime contractors who will be using the finished piece.

The "selling" of plastics as an excellent functional class of materials has been aided to a great degree by the jobs which they have already done successfully. From many officials and engineers in the armed services one gets the impression that there is a generally better attitude toward the use of plastics than there was at this time a year ago. But it is apparent that one job poorly done counteracts twenty jobs well done.

Finding jobs for plastics. Any plastics molder, laminator, or fabricator going into a prime contractor's plant should keep his eyes open for possible conversions to plastics. As an example, one molder was going through an electric appliance manufacturer's plant and saw a luminous button to be located beside light switches aboard navy vessels so that they may be found in the dark. This molder immediately saw

COMPRESSION MOLDING PROCESS

Percent of Total Number of Machines and Extent of Operation as of June 30, 1942, Showing Percentage Distribution and Utilization

Rated capacity in ounces per shot	*Machines in place June 30, 1942*	*Percent of total number of hours for all machines included in each classification during payroll week ending nearest June 30, 1942*		
	Percent of total	*Hours actual operation*	*Hours potential maximum operation*	*Maximum operation in use*
Total all machines	*100.0*	*100.0*	*100.0*	*51.1*
50 tons or less	34.7	37.5	34.7	55.3
51–200 tons	54.0	51.6	54.0	48.8
201–500 tons	10.6	10.1	10.6	48.8
501–1000 tons	.6	.7	.6	57.5
Over 1000 tons	.1	.1	.1	44.2

Injection Molding Process

Percent of Total Number of Machines and Extent of Operation as of June 30, 1942, Showing Percentage Distribution and Utilization

Rated capacity in ounces per shot	*Machines in place June 30, 1942*	*Percent of total number of hours for all machines included in each classification during payroll week ending nearest June 30, 1942*		
	Percent of total	*Hours actual operation*	*Hours potential maximum operation*	*Maximum operation in use*
Total all machines	*100.0*	*100.0*	*100.0*	*53.2*
2	23.2	23.0	23.2	52.8
4	19.8	22.3	19.8	59.9
6	14.1	15.3	14.1	57.7
8	19.1	20.1	19.1	55.9
9	2.8	2.3	2.8	43.0
12	5.6	5.7	5.6	53.8
16	1.1	1.5	1.1	73.5
Other	14.3	9.8	14.3	36.7

that there was no functional difficulty in using plastics and sent a sample of the button encased with nickel plated metal along with a two-piece molded plastic luminous button to the Office of Procurement and Matériel, Office of the Secretary, Navy Department, Washington, D. C. The result was a conversion from the metal casing to the plastic casing for all these buttons, and there are many thousands of them. This may seem a trivial item but multiplied by many similar cases, plus the many thousands used, it amounts to a sizable consumption of plastics and savings in other materials. Any molder who sees a Navy Department part which he thinks can be made in plastics can inquire about it through the Office of Procurement and Matériel, Office of the Secretary, Navy Department, Washington, D. C.

Anyone bringing such items to the attention of this office should state the name of the plant in which the items to be converted were seen, the name of the item, the description of the item, if possible a sample of the item, and a clear indication or sample of how it could be made of plastics. On items where the function of the piece is not known or where the performance standards are not known, the sender should request additional information so that he may determine whether plastics can do the job properly.

This applies to items of a general nature. On Ordnance equipment, the same type of information should be furnished to the Plastics Section, Bureau of Ordnance, Navy Department, Washington, D. C.

This is necessary because the Navy has no museum or central showplace for products used by the Navy, whereas the factories and plants of prime contractors are practically exhibitions of Navy parts. As said before, the prime contractor must be sold on the idea of using plastics. This will sometimes be difficult because it means that machinery which he has been using for the product to be replaced by plastics will be idle. But it would not be too difficult to convince a prime contractor that such machinery will not long remain idle or, as a matter of fact, never really be idle because, before the change-over to plastics can be effected, new uses for the metal working machinery will be found.

It is absolutely vital that the prime contractor be convinced of the superior quality of plastics where such a prime contractor is working on a performance contract.

A performance contract is a contract, the terms of which, broadly speaking, provide that the finished item will live up to certain standards of performance. The prime contractor is practically free to determine how his piece is to meet such standards of performance. A typical example of a performance contract is a contract for finished airplanes in which there is usually very little limitation as to what materials are to be used so long as the performance of the plane is up to the standard set in the contract. Where a prime contractor is operating under such a contract, the Government may not dictate a change in the materials to be used although the contractor himself may ordinarily make such changes without

Extrusion Molding Process

Percent of Total Number of Machines and Extent of Operation as of June 30, 1942, Showing Percentage Distribution and Utilization

Cylinder diameter	*Machines in place June 30, 1942*	*Percent of total number of hours for all machines included in each classification during payroll week ending nearest June 30, 1942*		
	Percent of total	*Hours actual operation*	*Hours potential maximum operation*	*Maximum operation in use*
Total all machines	*100.0*	*100.0*	*100.0*	*41.0*
2 inches	12.1	11.5	12.1	39.1
2 1/2 inches	28.6	17.2	28.6	24.6
3 1/2 inches	10.9	11.9	10.9	44.8
4 1/2 inches	14.5	13.7	14.5	38.8
6 inches	17.7	27.8	17.7	64.2
8 1/2 inches	...	...	...	..
Other	16.2	17.9	16.2	45.4

COLD MOLDING PROCESS

Percent of Total Number of Machines and Extent of Operation as of June 30, 1942, Showing Percentage Distribution and Utilization

Rated tons pressure	Machines in place June 30, 1942	Percent of total number of hours for all machines included in each classification during payroll week ending nearest June 30, 1942		
	Percent of total	*Hours actual operation*	*Hours potential maximum operation*	*Maximum operation in use*
Mechanical:				
Total all machines	*100.0*	*100.0*	*100.0*	*26.2*
50 tons or less	96.8	100.0	96.8	27.1
51–200 tons	3.2	...	3.2	..
201–500 tons	...	...	...	..
Over 500 tons	...	...	...	..
Hydraulic:				
Total all machines	*100.0*	*100.0*	*100.0*	*34.7*
50 tons or less	83.1	78.5	83.1	32.8
51–200 tons	13.1	17.6	13.1	46.5
201–500 tons	3.3	3.9	3.3	41.1
Over 500 tons	.5	...	.5	0

bothering to get Government approval, so long as the finished airplane lives up to the performance standards set up under the terms of the contracts. Obviously a selling job on the efficiency of plastics in functional parts would pay dividends in business when dealing with such contractors.

Another present large user of plastic laminates and molded parts is the Quartermaster Corps, U. S. Army, but there is still room for increasing the number of items used. Responsible officials in the Quartermaster Corps have said repeatedly that there has been no cheapening of the Quartermaster Corps items by the change-over to plastics from materials formerly considered standard. As a matter of fact, in every case the items have been improved, according to these officials. The factors to be considered in producing and designing Quartermaster Corps items are varied: decreasing weight, combination of functions, simplification of a line of goods, increasing the fighting efficiency of the individual soldier, improving the durability of the material, regulating sizes, eliminating light reflecting surfaces, and rivets and screws. The Quartermaster Corps does not regard the use of plastics as a substitute but rather as an improvement. The Corps is carrying on constant research in the various laboratories, factories, schools and universities throughout the United States to improve the Army's line of equipment. It is also cooperating very closely with the other branches of both services which are doing similar jobs.

In Ordnance equipment for the Army lies a tremendous field for expansion in the use of plastics. As illustrated above, the tests to which Ordnance equipment is put are very stringent. Any molder, fabricator or laminator of plastics who is going to attempt to convert a piece of Ordnance equipment to plastics must be thoroughly familiar with the test which the particular part he is trying to convert will undergo. One thing must be borne in mind when tackling Ordnance conversions and that is that the volume of material to be purchased is calculated in almost astronomical amounts. For example, on one Ordnance contract alone through a mere redesign of an item, 8.7 carloads of steel were saved. On another item, a primary case formerly made from brass was converted to pressed steel and 23,352,000 pounds of brass were saved on projected Ordnance requirements through 1943. This merely illustrates, on two comparatively small items, what a terrific amount of Ordnance equipment is used. So another factor is interjected into the problem of conversion to plastics—the factor of material supply. In figuring on Ordnance conversion, the molder, fabricator or laminator should be careful and should try to ascertain what the material requirements of the job will be and then attempt to get an estimate from WPB as to whether he can get that much material on the priority which the job will bear. Above all, he must not submit any suggestions for Ordnance matériel without checking the function of the piece. A close cooperation with the district engineers and the conversion engineers in the district offices of the Ordnance Department should be established and maintained.

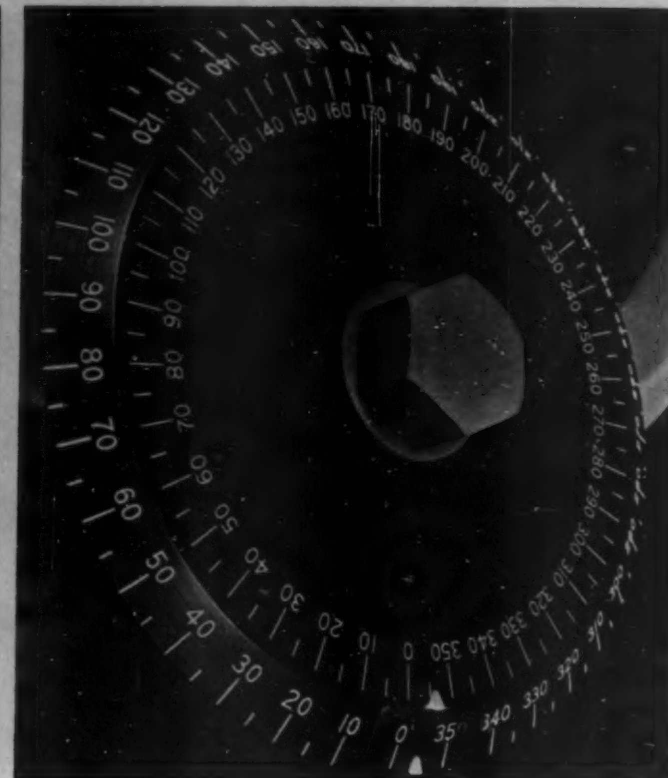
There are conversion engineering sections in every Ordnance District throughout the United States. Headquarters of these districts are located as follows: (*Please turn to page 148*)

ESTABLISHMENTS REPORTING

Percent of Total Establishments Reporting Showing the Percentage of Establishments with Excess Machine Capacity Available for Additional Production in the Plastic Moldings Industry as of June 30, 1942

Process employed	Percent of owners willing to:		
	sell equipment	*lease equipment and provide labor*	*lease equipment but not provide labor*
Total all processes	*3.1*	*22.5*	*4.8*
Compression molding	2.8	16.8	3.9
Injection molding	2.9	19.3	4.1
Extrusion molding	...	17.8	2.7
Cold molding	...	15.4	...

1



1—Electrical and mechanical properties of laminated phenolic material brought about its choice for the azimuth dial. Here protractor is held in a vise during the branding operation. 2—Finished dial assembled to its metal stanchion

Road map for navigators

AMERICA'S arms and the men who use them must reach the war's battlegrounds before they can help turn the tide of victory. Both must be carried by ships. To leave one port and arrive safely at another, navigation instruments must be used. One important aid to navigation is the azimuth dial, usually located in the sky lookout of the ship, which enables the user to calculate a ship's position by determining the position of heavenly bodies in relation to the horizon. If the size of the ship warrants, there may be several of these dials aboard.

Prior to the current tightening up of metal supplies, the unit was made of heavy brass. Now plastics are being used, and a material designated as Type PBG has been specified. This is a laminated phenolic with a paper base, suitable for a general purpose material where the wide range of applications requires a balanced combination of electrical and mechanical properties. Definite requirements with regard to water absorption, volume resistivity, insulation, dielectric strength, molding pressure, power factor, dielectric constant, loss factor, arc resistance, impact strength, flexural strength, deflection, modulus of elasticity, compressive strength, tensile strength, bonding strength and machinability are set forth in standard specifications.

The laminated phenolic selected for the azimuth dial is a good all-purpose material with excellent machinability and a high degree of resistance to moisture, steam and salt water. The fact that it will not warp or pit is a significant consideration in a measuring instrument where the calibrations must be true. It is lightweight, corrosion- and abrasion-resistant, and will not score or adhere to metal.

The instrument consists of a black laminated phenolic disk, $11^1/_2$ in. in diameter, and $^1/_2$ in. thick. Two protractors of the same material are set on the base disk, and function as indicators. The whole assembly is set on a metal stanchion. In the fabricating process, the material is cut into squares 12 in. by 12 in., jig-sawed, and turned on a lathe to give it the proper contour. A 1-in. beveled edge is formed on a sander, and the calibrations (in fifths) are impressed on the beveled edge as well as on the adjoining flat surface. The two protractors are jig-sawed, sanded and evened off to conform with the designated dimensions. There are no finishing or polishing operations necessary because the material itself has a dull, smooth finish.

After a material that combined the designated properties had been secured, the problem became one of developing a method of marking the dial that allowed the smallest possible margin for error, and at the same time was not prohibitively expensive. At first, engraving was attempted. This process, however, was time-consuming and too costly to be practical. Finally one fabricator hit upon the expedient of branding. This method of marking dial and protractors combined in one process accuracy, permanence, *(Please turn to page 124)*

First aid carrier

A bright red kit, no larger than the make-up box the average woman totes, flies in Navy planes, bearing 10 first-aid packages for emergency treatment. Top, bottom and handle are produced in one mold. Rear view of the kit (below) shows metal clips for wall attachment

COLOR PLATES, COURTESY CELANESE CELLULOID CORP.

WHEN a pilot is hurt in action or in a forced landing, no doctor is handy to attend his wounds. First aid is often the difference between serious infection and death or minor injury and life.

Thus every airplane of the United States Navy carries somewhere in its interior a fiery red first aid kit containing ten unit packages of various first aid bandages and medical preparations for treating injuries received by its crew in the line of duty. Originally these kits were made from aluminum. Now, however, injection molded cellulose acetate has replaced the aluminum box and is doing an excellent job.

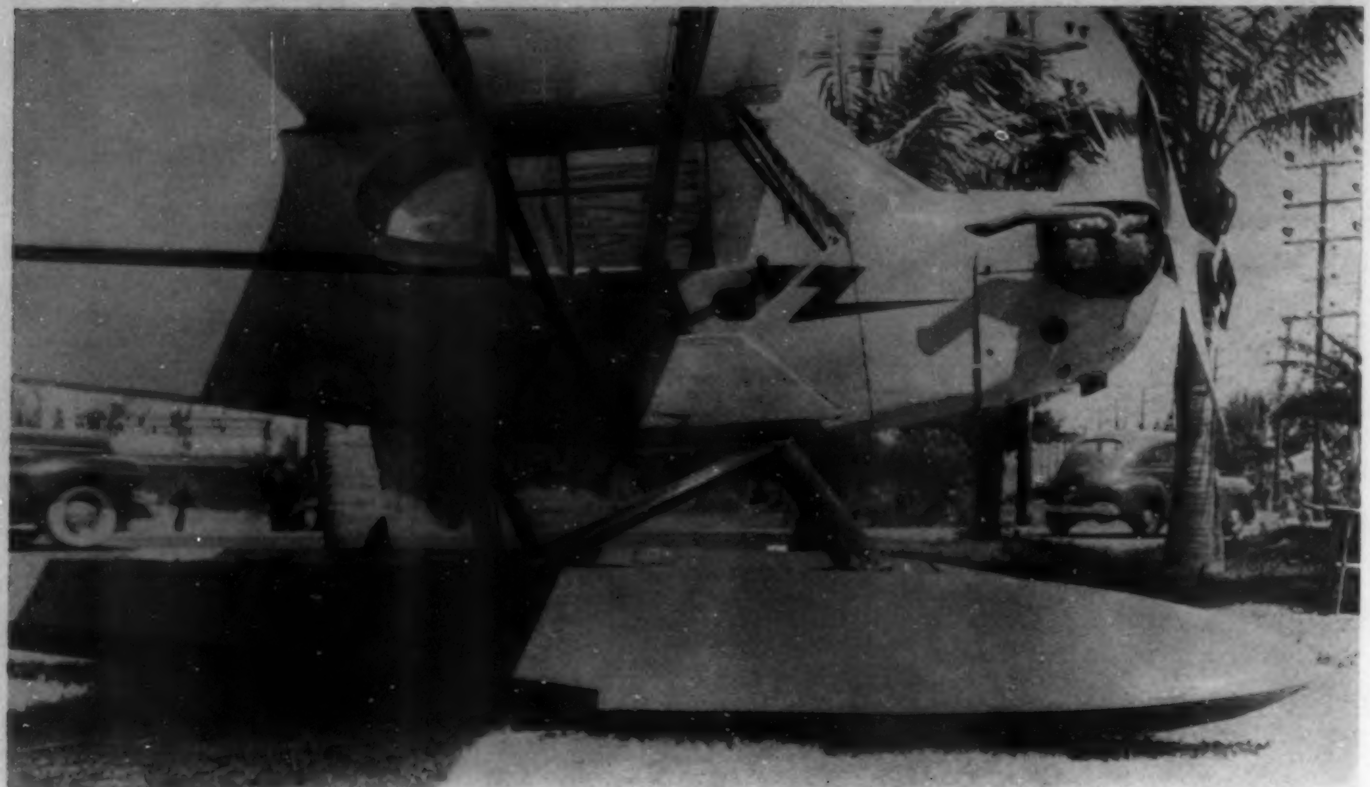
Exclusive of hardware, the plastic kit weighs only six ounces. Fully loaded kits are tested by dropping them 15 feet on a hard surface, and they must not break or chip in the process. The catch, handle clips and hinge for the kit are still made of metal, riveted to the box by hollow aluminum rivets inserted by a magazine type riveting machine.

A compact unit, the kit (when closed) measures 7 in. by $4^1/_4$ in. overall and has a total depth of $2^3/_8$ in.—ample room for carrying the first aid packages.

The bottom, cover and handle of the box-like kit are all made in one mold. When the parts come out of the mold, the molder simply cleans off the gates, and the parts are ready for assembly to the hinge and lock. About 2000 sets of the bottom, cover and handle can be molded per eight-hour day. The acetate handles have enough spring so they can be inserted after the retaining clips are riveted to the case.

Close attention had to be paid to the molding because it was found that the parts had a tendency to warp in coming out of the mold if not properly handled. This was overcome, however, by close control and sufficient dimensional stability was achieved to permit speedy assembly of the boxes.

It is also interesting to note that the mold was so large that its corners had to be cut off to make (*Please turn to page 136*)



ALL PHOTOS, COURTESY CROSLEY MARINE

1

1—Cub seaplane equipped with experimental floats laminated by low pressure methods. Lighter than aluminum pontoons, with no rivet heads to cause drag, these floats take off faster

Low pressure laminates for aircraft

by POWEL CROSLEY III

UNDOUBTEDLY low pressure laminating can and will be one of the outstanding contributions made by the plastics industry to the war effort. Today, using no complicated dies or molds, but instead molds of cheap wood, plaster of Paris and concrete, Crosley Marine of Miami, Florida, has developed methods for fabricating the most complex curved and shaped parts practically without pressure.

As yet we can find no limiting factors. Before the war is over, we have no doubt that aircraft can be fabricated completely by these methods. Although our efforts are confined at present to non-structural parts, this field alone is proving to have tremendous possibilities. The substitution of this laminated plastic for aluminum in aircraft not only provides a less costly product, but also one that has many decided advantages in fabrication over its predecessor. The process is not limited, we believe, to non-structural parts. As experimentation continues, with the cooperation of the large resin manufacturers, the strength of the parts and the material itself are improving vastly.

Although the company's developments are for the most part concerned with aircraft, it has also designed an array of laminated products such as boxes, radio cases, boats of inboard and outboard types, pontoons and water coolers. In the case of the water cooler, an inside lining of the new material was constructed on an experimental basis to replace a normally used galvanized liner.

Our introduction to this tremendous new field of endeavor was a modest one, brought about by necessity. Over a year ago, due to the speeding up of production and the increase of freight rates, our firm found it necessary to find some new method for the construction of low-priced boats. We had been building plastic-plywood boats, the hulls of which were constructed over our molds by a large plywood concern, using the Vidal process. This had definitely spoiled us for the older, costlier methods of small boat construction. Our first boat was made of a combination of wood fiber and fabric, impregnated in alternate layers without use of heat or pressure. The finished product weighed less than fifty pounds and definitely proved to us that we were on the right track and in an entirely new field. This first experimental boat is still in constant use, somewhat over a year since it was built.

After constructing this first boat we constantly improved on our product, reducing its weight and removing framing and ribs. The boat was successfully placed on the market and was well received until we had to discontinue it because of the war.

When aluminum became scarce, interested flyers in and around Miami, some of whom had purchased our boats, suggested that we ought to try our process for building a set of pontoons. They thought that a pair of floats for light aircraft, if they were approved, could be used by the C. A. P., which was just then coming into the picture. After studying

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2—Non-structural airplane parts laminated under low pressure. In foreground, aircraft fairings. Step wells at left. Girl at right holds a spoiler tab. 3—First low-pressure laminated dinghy weighed but 50 lb. 4—Foot wells molded under low pressure. 5—General Manager Powel Crosley III holds a fairing part laminated by his firm's new process

this situation and discussing it with several aeronautical engineers, we agreed that a satisfactory seaplane float could be built by our laminating methods. Construction was undertaken and a little over six months ago the pontoons were ready for test.

We attached them to a small seaplane, and flight tests were conducted in Biscayne Bay with results which were far beyond our expectations. The man-hours involved in making them were considerably fewer than those employed in aluminum fabrication, and the pontoons themselves were lighter in weight. We found that they would take off faster than the aluminum floats; and the pilot, who was a seaplane man, was exceedingly high in his praise of them. Naturally, we had one advantage over the aluminum method of construction in that we had no rivet heads, which greatly reduced the drag.

As can be seen, we now have the cart before the horse. We took, first of all, a highly experimental plastic, which certainly at the time had not been proved, and we attached pontoons fabricated of it to an airplane which successfully flew. I think we can say that we have the distinction of having the first true laminated plastic to fly. Of course, there will be arguments about this, due to the fact that the use of wood laminates in aircraft is much older.

The evolution of our process from that point to our present position has been a slow, tedious one and we have learned step by step. According to our friends in the industry, we have broken some of the rules, *(Please turn to page 148)*

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ALL PHOTOS, COURTESY BAKELITE CORP.

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1—A group of blanks punched from phenolic resin board. When molded, they will form parts of exceptional strength. 2—Army mess kit knife has a handle molded from two matching blanks of phenolic resin board

New uses for phenolic resin board

NEW wartime applications of phenolic resin molding board and blanks are calling attention to the potentialities of these products where impact resistance is a requirement. As far back as 1932 they were demonstrating their adaptability to an important number of industrial applications, and today when the major requirement in practically all types of phenolics is high impact strength, industry is rediscovering their unique properties.

Best known of the group is phenolic resin molding board, which is classed as a medium high impact material, with impact strength of .85–1.2 on A.S.T.M. Izod test. Its tensile, flexural and compressive strength is unusually high for a material with such outstanding impact resistance. It is produced by combining various types and quantities of resin and fibers on paper-making equipment. The resulting boards are then supplied in various size sheets or more generally in shapes cut to the approximate design of the finished part. Since these blanks, as they are called, are virtually preforms, they can be loaded directly into the mold.

Most unusual characteristic for an impact-resistant plastic, however, is the low bulk factor of 1.5–1.0. This makes it possible to fabricate finished parts in molds designed for general-purpose phenolics. Since wartime service demands that existing product designs be adapted to materials tougher than those used in the past, it is often necessary to make the change immediately. Whereas fabric-filled impact-resistant materials would require deeper and stronger molds to accommodate greatly increased bulk factor and molding pressures, the use of molding boards or blanks requires no change in molds, and only minor modifications in technique.

Different types of board offer a variety of combinations of mechanical and electrical strength, surface appearance, flow and moisture resistance. By lowering the resin content of the material, higher mechanical strength may be obtained, but this lowers flow, finish, and water-resistant characteristics proportionately. Either fast-curing or slow-curing types of resins can be used, thus still further increasing the diversity of relationship between properties.

Molding blanks or boards may be used alone in producing the finished product, or they may be employed in conjunction with standard types of phenolics to provide reinforcement at vital points. Frequently parts that are subjected to mechanical shock require color, surface electrical properties and other characteristics not obtainable with molding blanks alone.

3—Diced or macerated resin board is granular in structure, has high impact strength, low bulk factor. Surfaces of articles molded from it look like those of phenolic pieces, although pressures required are relatively low and temperatures of 290°–310° adequate

3

In such instances the blanks may be used merely as a core for the outer material, a combination impossible without blanks.

Resin board is especially desirable where small molded parts—cams, for instance—must have high mechanical strength. Molding powders or preforms lack the desired toughness when fabricated into tiny sections. By using a free-flowing grade of resin board, however, impact-resistant pieces as small as $^1/_4$ in. square may be produced successfully. While it is true that maximum strength demands minimum flow, the mechanical properties obtained exceed those of general-purpose phenolics.

Newest and most important development in the resin-board family is a diced or macerated type with an impact strength of .38–.45 ft.-lb. energy to break by Izod test. Although 3 to 4 times more resistant to mechanical shock than the general-purpose woodflour-filled phenolics, it can be preformed on both single stroke and rotary tabletting machines. Cut to pass U. S. Standard 6 mesh screen, it will feed through the hoppers of automatic molding presses as readily as general-purpose materials. It provides all of the toughness, water resistance and other physical characteristics for which standard types of resin boards and blanks long have been known. Its surface appearance, when it is molded, is comparable to that obtained with regular phenolics.

Tensile strength of standard molded test specimens of this new diced molding board ranges from 4500–5500 p.s.i. and flexural strength from 7100–8500 p.s.i. Water absorption after a standard 24-hr. A.S.T.M. test shows a gain of only .40–.90 percent. Even after 5 hr. in boiling water, a 2-in. disk molded from this macerated board revealed a maximum gain of 1.9 percent. Dielectric strength at 60 cycles is 110–125 volts per mil (step method), and volume resistivity is 2–3 $\times 10^3$ megohm centimeters. To secure maximum electrical properties, however, the material must be preheated. Both dielectric strength and volume resistivity may be doubled by subjecting charges to 200° F. for 30 min. immediately prior to molding.

An important advantage of diced molding board is its relatively low bulk which, in common with that of other molding board materials, permits its use in molds made originally for general-purpose phenolic, an aid in saving time and cost. Fabric-filled impact-resistant plastics, on the other hand, demand extra deep molds to accommodate their greater bulk and more adequate heating of the platens for correct flow. Furthermore, the vastly increased molding pressures necessary with fabric-filled phenolics call for molds of considerably stronger construction than those for woodflour-filled materials. Molding pressures for diced board, on the other hand, are relatively low—ranging from 5000–5800 p.s.i. Molding temperatures of 290–310° F. are adequate.

Diced resin board is adaptable to a wide variety of applications where impact- and shock-resistance and high-speed fabrication are required, such as on the receivers and transmitters of sound power telephones and for the handles of large circuit breakers. (*Please turn to page 144*)

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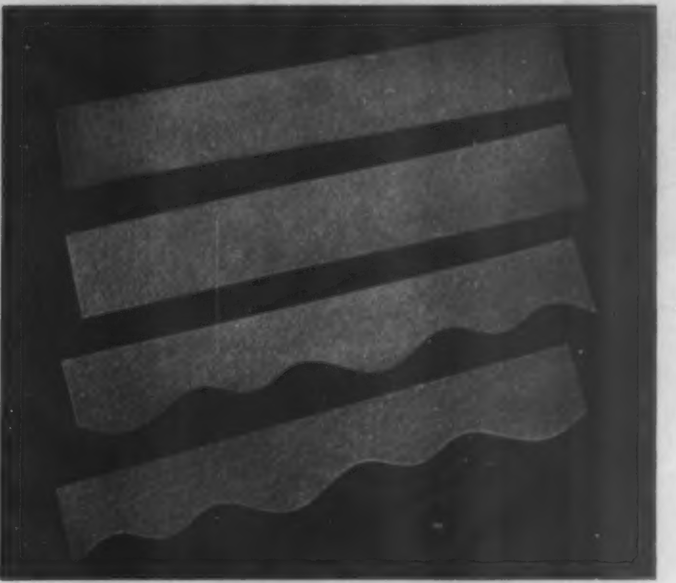

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4—First step in molding industrial goggle frame of phenolic resin board is to cut one edge of both strips to approximate contour of finished frame. 5—Strips are then dampened, coiled and dried—a preforming operation after which they are molded without further preparation. 6—Rings to hold lenses (below) are molded from flat stamped sections of the phenolic board. 7—Headband and lenses complete assembled goggles

PRODUCT DEVELOPMENT

Map and data cases

Plywood has come into its own within the past few years, particularly as an alternate for numerous critical materials. In modern aircraft, plywood has been a "natural," both inside and out for lightweight interior fittings, flooring and accessories and for the fuselages of trainers and small bombers. The combination of great strength and durability with minimum poundage is achieved by the application of synthetic resin adhesives or impregnating resins to various types of plywood veneers, by molding or laminating.

The map and data cases shown are fabricated from a special type of resin-fused paneling. It consists of a wood veneer or plywood core with sheets of vulcanized fibre in various weights and thicknesses resin-bonded to each face by the hot plate method. The resulting panel is unusually tough, yet is easily worked by sawing, drilling, die punching or bending. The tough, hornlike surface resists cuts and scratches and is non-splitting. Crazing and checking are minimized. Absorbent to paint, dope and waterproofing mediums, the even mat surface takes all types of finishes, including air dry and low bake synthetic enamels.

Because of its fibre facings, the material can be shaped with right angle bends as shown in the joints of these aircraft cases. For example, one data case has four pieces—two ends, body with three breaks and one lid; hinges and gussets are fabric; and the total weight is 15 oz. Others are similarly made, in some cases, with strengthening reeds to meet additional strains. Weights range from 9 oz. to 1 lb. 12 oz. Combination units with separating partitions and pencil holders are a few of the items made for aircraft purposes. The flexibility of the material for such special shapes is its chief merit. Actually a sheet of the resin-bonded fibre-plywood material can be bent on a hot roll to a radius of $^1/_2$ in. and sections have been virtually bent double without damage.

Credits—Material: Fybr-Tech, product of Technical Ply-Woods

Telephone on the hook

Number please! Railroad repair and train crews need not wait for recalcitrant operators to connect their telephones with headquarters when they are supplied with Universal Line Pole. This unique pole is designed primarily for use by railroad crews in connecting a portable telephone to a circuit along the right-of-way (see photo at extreme left). The cable is attached to the portable phone held by the repair man, while the two hooks on the head are engaged on overhead telephone wires. When the conversation is concluded he merely lifts the pole, releasing the hooks from the wires.

To obtain a lightweight, insulated enclosure for the head on top of the pole, compact housing of molded polystyrene was designed (right) to replace the original cases of die-cast aluminum and later of laminated phenolic which had been used previously. In addition to being high in dielectric strength, the polystyrene molding is light in weight, has a specific gravity of 1.06 and is very low in water absorption.

The housing consists of two halves, each molded in a single cavity die. These are clamped together to fit closely and fastened in place with several screws which also help to hold the inner mechanism and attachments such as the hook which hangs over the line and the spring guide at the right of the housing.

Credits—Material: Bakelite polystyrene. Molded by St. Louis Plastic Moulding Co. for James R. Kearney Corp.

Fumigation under tarpaulin

During war, more than ever, potential food supplies such as grain and feed must be protected against insect-infection even when located far from adequate fumigating facilities. The coordination of chemicals and plastics provides the solution. The fumigant, methyl bromide gas, is carried through heat, gas and chemical-resistant flexible saran tubing to the infected material which is protected by an ethyl cellulose-coated, gas-tight tarpaulin. Immune to gas attack, the ethyl cellulose coating is applied to a light duck fabric heavily coated on the inside and lightly on the outside. It is impervious to ultraviolet light, is fire-resistant and won't crack with age.

The infected material is placed on an air-tight surface free of cracks, preferably concrete. Stacked in a square area to a height of approximately 5 or 6 ft., four sacks are placed in an upright position on the top of the pile to form a gas expansion dome (see top photo). Here gas is introduced from the cylinder through a tough saran tube to the tarpaulin covered pile, the edges of the sheet being sealed against the floor with canvas "snakes" filled with sand (lower photo). At the end of the fumigation period—which takes approximately 12 to 18 hr. depending on the space and type of material exposed —the cover is partially pulled back to allow a 30-min. airing.

Credit—Materials: Ethocel, Saran. Gas by Dow Chemical Co.

Molded pistol grip

Replacing aluminum and rubber, the plastic pistol grip illustrated below is mounted on the control stick of U. S. Army Air Corps planes and is operated by the pilot for firing fixed guns. The black cellulose acetate butyrate of which it is molded offers the outstanding properties of high dimensional stability, impact strength, good weathering and low moisture absorption. Its weight is only 4.5 oz., including the gate. Finger grooves and cross hatching give a firm grip. Elimination of the sticky condition caused by moist hands on rubber, which sometimes results in the handle cover becoming detached, is an important feature. By the use of the plastics medium selected there is no limitation to the forms of design which may be made. Its light weight, of course, is a major item on aircraft.

The complete grip can be made in one operation, without such additional machining operations as are required for grips made of aluminum castings with rubber covers. The insertion of the switch is, naturally, a separate operation. Intricate interlocking cores are constructed in the die which form undercuts in the pieces, and a metal insert molded in the base of the handle gives added strength and rigidity The molding cycle of 90 seconds is rapid, considering the extremely heavy section of $^1/_2''$ by $^1/_2''$ and the close tolerances to which the pieces must be held.

The electric bomb racks are controlled by the double circuit trigger and button on top of the pistol grip, which lie immediately under the pilot's forefinger and within an inch of his thumb as he grasps the handle. Another style grip is available with single circuit actuated switch. Practically instantaneous release is obtained with this method, which was not true of the former mechanical type of bomb control.

Credits—Material: Tenite II. Molded by Erie Resistor Corp. for Guardian Electric Company

Extruded saran pipe for industrial plants

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WHEN chemical processing plants cannot get sufficient metal pipe for their industrial needs, it is only natural that they should turn for assistance to the chemical industry itself. The plastics branch of that industry, most thriving offspring of a versatile parent, has to date provided scores of products which have functioned as well or better than their metal predecessors. It is not strange, therefore, that plastic piping should be made available for chemical plants, oil, gas or water companies, and other establishments in need of conduits resistant to water and chemicals.

One such pipe is molded of saran by a modified extrusion process in the same dimensions as extra strong iron pipe of 2 in. OD or smaller. The pipe is tough, durable, flexible, non-flammable and non-scaling. Other announced properties are its resistance to the abrasive and corrosive action of soaps, oils, chemicals and moisture. It resists freezing and is heat-resistant to 170° F. In the accompanying table are listed the results of wide range chemical resistance tests conducted with the pipe over a three-month exposure period.

Production of this pipe by a modified extrusion process results in smooth, round, accurately sized lengths with dimensions identical to those of extra strong iron pipe. At present, available sizes are 1/2 in., 3/4 in., 1 in., 1 1/4 in., 1 1/2 in. and 2 inch. Larger sizes are promised in the near future.

Sharp standard pipe dies can be used to thread the pipe, an operation which exactly parallels cutting of standard pipe threads on metallic pipe, and make it practical to install it with either metallic or saran fittings (see Fig. 1). Very sharp dies should be used to ward against deforming of the pipe, and to secure threads that are sharp, clean-cut, and will not cause leaking. Use of a lubricant is advised.

Standard flanges are available in sizes from 1/2 in. through 2 inches. These are standard iron pipe bolted companion flanges that conform to present size specifications. Other fittings, such as couplings, reducers, nipples, ells, bushings and plugs, will be available as rapidly as molds can be constructed. Methods for fabricating valves are being studied.

An important factor in shipping, general handling and suspension is the weight of the plastic pipe—less than one-quarter that of iron pipe.

Welding operations with the pipe are simple, rapid and can be accomplished in less than one minute (see Figs. 2, 3). Two lengths of pipe are placed on a hot plate (temperature 350° to 400° F.) and held long enough to form a small inventory of molten material. A plate with a smooth nickel or chromium surface is preferred. The bead or molten material inventory is visible in Fig. 1 at the outside surfaces of the two pieces. Then the two ends are pressed together and allowed to cool for a few seconds. Within 24 hours the welded joint is said to have strength equal to that of any other portion of the pipe. (*Please turn to page 132*)

1—Saran pipe may be threaded on standard pipe threading equipment, but pipe dies should be sharp. 2—To weld the pipe, hold two pieces on hot plate until a molten material inventory appears. 3—Press ends together and allow to cool for 10 seconds. After 24 hours, joint will be as strong as the pipe itself

PHOTOS, COURTESY GENERAL ELECTRIC CO., PLASTICS DEPT.

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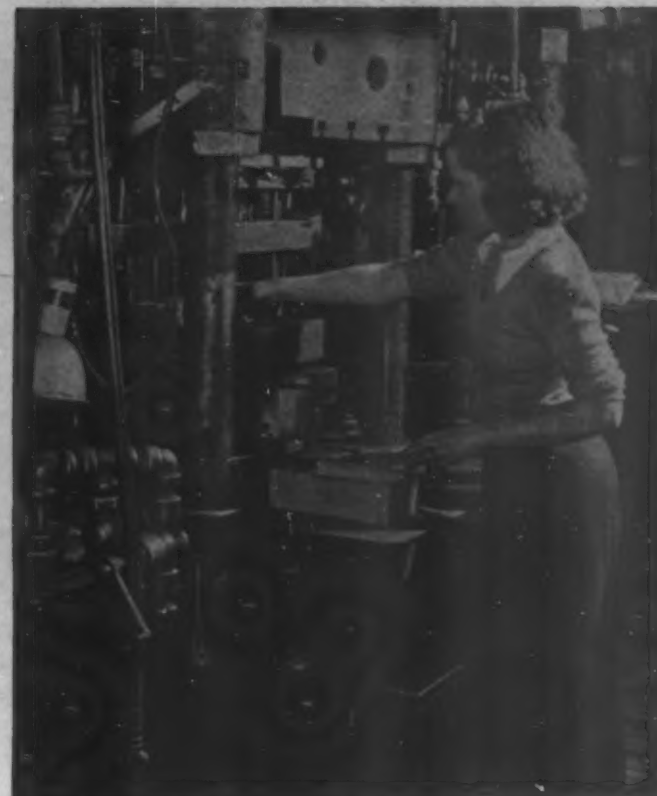

2

1, 2—*Women press operators will be seen more frequently in plastics molding plants as more men are drawn into the armed forces. Semi-automatic, automatic presses requiring minimum lifting of heavy molds are easiest for women*

Woman power in the plastics industry

THE old adage of "man works from sun to sun, but woman's work is never done" is hitting American industry harder than block-busting bombs. Man still works from sun to sun—and later—but unfortunately for industry his work is being done in an Army uniform all over the world. To keep the wheels of industry turning, women have had to jump in and do the job.

American industry now employs two and a half million women out of a total population of approximately one hundred thirty-two million people. In Germany, out of a population of approximately eighty million people, over nine million women are employed in industrial jobs.

The War Manpower Commission estimates that if the need for men in the armed forces continues to expand and the nation continues to use its full productive capacity, more than five million additional women will be needed in factory work by the end of 1943 and five million more by the end of 1944.

As an essential war industry, plastics rates high. Production in the plastics industry must be kept up. Many companies in the industry are already using women in jobs which have been traditionally labeled "for men only." But as the Selective Service Act digs deeper into the 18- and 19-year old class, and into the childless married men, the plastics industry will inevitably have to tap this new and vast labor source.

To do this, there must be a carefully reasoned approach to the question of using women in the plastics industry. The problem of using women breaks down into several major phases. First, before any plastics molder, laminator, fabricator or materials manufacturer can hire women to do the jobs that have customarily been done by men, he must attract women to the employment office to apply for those jobs. There are many opinions as to whether this problem will grow less or more acute as the war continues, but to be on the safe side it may be assumed that it will grow more acute. Second, the treatment of women applicants in the employment office is important, since it differs from that accorded men applicants for positions. Third, the training problem varies because women have less mechanical background and must be taught the fundamentals of the use of machinery, hand tools and materials. Fourth, personal cleanliness, rest, recreation, cafeteria service, transportation and care of children are problems which come more sharply into focus in dealing with women, and the personnel manager must realize this in dealing with women employees.

Wherever industrial management has been hidebound by tradition as to which jobs could be done by men, which by women, there has been a sort of awe as to the vast number of additional problems created by the hiring of and training of women. But after more study and with a more thoughtful approach, these same companies have discovered that the problems of hiring women are exactly the same as those of hiring men. True, some aspects of these problems become more important when dealing with women, but the fundamentals are no different. This point is extremely important

and makes the analysis of difficulties in hiring women in any given plant much easier.

For example, one personnel manager said, "Well, I don't see any reason why we should have to install additional equipment such as steam tables. We have never had one and the men haven't said anything about it. Why should we give women special treatment?" Upon a closer checkup, it was found that the men in this same company did want a cafeteria. When it was put in largely for the benefit of the women, it was found that the men used it too, and liked it. Incidentally, the labor turnover in this particular plant subsequently decreased by about $8^1/_2$ percent, which more than paid the cost of installing the cafeteria.

The employment office

Getting women into the employment office for interviews is one of the toughest problems that the personnel manager is up against today. One large aviation company had an independent research corporation conduct a survey as to the reluctance of women to enter war industries. The results of this survey were undoubtedly influenced by local conditions in the area where the plant is located, but certain generalizations can be drawn from it.

First, much to the amazement of the company, the survey disclosed that although women generally, and particularly non-working housewives, were vaguely aware of a manpower shortage, practically none of them really understood that the shortage was becoming so critical that it might eventually touch them. In other words, they did not know that they were needed. This being the case, they did not apply for jobs. In addition to this, a large percentage of the women, who *did* realize that there was a labor shortage in the manufacturing industry and that they might aid in solving the problem, had had in the past very unpleasant experiences when they applied for jobs. They had been treated brusquely, made to wait for interviews, figuratively and sometimes literally shoved around and in general not treated as if they were wanted. Instead it had seemed to them that the hiring companies took the attitude that they were doing women a big favor in even letting them step into the employment office.

It was found that the classified ads offering jobs in war industries—and this was particularly true where plastics industry was concerned—were not read by women and were not reaching women. One large plastics molder ran a classified ad offering jobs to women for a week in a local newspaper, kept its employment office open every night during that week and it succeeded in hiring only five women.

Little or no social pressure has been brought to bear on women to take industrial jobs. Indeed, the opposite has been true among the middle-class and lower-middle-class working group. Thus women who have husbands making enough money to support the family seem to feel that there is some social stigma attached to going back to work, especially in a factory. This is a very difficult problem to overcome because this group of non-working women represents the largest untapped labor source in the country. Lastly, the woman with small children needing daytime care while she is working, presents a difficult situation. In order to get her into the employment office, some provision must be made by the company either on its own or in cooperation with local or Federal authorities to have proper care taken of the children during the working hours of the mother. Not only must this provision be made but it must also be sold as an educational project and a distinct advantage to the child and not just as a scheme for "parking the kids" for the day.

Briefly, these are the hurdles which must be overcome before women in sufficient numbers can be attracted voluntarily into plants to do industrial work. How can they be brought in? Well, each company must work out its own program, depending on the particular situation with which it is faced. But it is quite obvious that employment offices can no longer handle applicants as though they were livestock. Treatment of all applicants for jobs, and especially women, must be

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PHOTOS, COURTESY GENERAL ELECTRIC CO., PLASTICS DEPT.

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friendly and receptive. The wait-in-line-maybe-Mr.-Jones-can-see-you approach must give way to a pleasant and cordial attitude by the receptionist toward the prospective employee. It has never made for really sound industrial relations to treat people as if they were a commodity. Today it is suicidal if a company is in real need of labor, and sooner or later every company will be in a highly competitive market despite job freezing or any other Government aids.

Classified advertising is obviously not the whole answer to getting women to apply for jobs. An intensive program of publicity should be carried on in local newspapers throughout the vicinity of the plant, showing women working in the plant, describing the conditions, mentioning the contribution they are making to the war effort, and in general using every possible appeal, both financial and emotional.

The personnel manager of one plastics company has found that going out into small towns throughout the section of the country where the plant is located and interviewing potential applicants with the aid of the United States Employment Service has proved a fruitful source of additional workers. It is important to note that big cities such as New York represent a poor labor potential for plants located in small towns. For example, the figures of the U. S. Employment Service show that not one person in a thousand will leave New York to take a job elsewhere. (*Please turn to next page*)

PHOTOS, COURTESY GUY P. HARVEY & SON

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3—Skilled instruction by good foremen cuts training time and increases productivity of new women workers once they are actually at work on machine tools. 4—Women excel on smaller machines because of their manual dexterity. 5—Assembling, roughening and sanding of loop antenna housing are done expertly by women at finishing tables. 6—Disassembling and assembling molds call for clever skillful fingers. 7—Mold making requires much training. This operator is using a duplicating machine to form an intricate mold. 8—Women are also excellent at finishing molds by hand operation

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PHOTOS, COURTESY GUY P. HARVEY & SON

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9—Extreme care must be taken by the woman operating this tool, which is cutting molds for plastic handles of knives.
10—An engraving machine is being used for cutting into the same mold the letters "U.S." for Army knife handles

Another company faced with the problem of getting women applicants is seriously considering setting up various employment information centers in the area surrounding the factory. These centers would be located in vacant stores. Pictures of women working in the plant would show typical operations, and each center would be under the direction of a woman employee who had had actual experience working on machines and could explain what it was like to work in a factory. These offices would not do any actual employing but would serve merely as a clearing office for weeding out the merely curious from those who really wanted a job.

Moving pictures, presenting interiors of plants where women are actually operating machines, shown before women's clubs and other groups especially gathered to see such programs have also been utilized with a fair degree of success.

Training women

Training women is a little bit different from training men. Strangely, the rewards seem to be greater. First of all, in a majority of instances women do not have to be "untaught" the wrong use of hand tools, machinery and equipment. They react much more favorably to safety devices and are less careless in the use of them. On the other hand, as a general rule they have little mechanical knowledge and must be constantly drilled in fundamentals with which most men are familiar because since boyhood they have tinkered with mechanical devices. There are, of course, exceptions to these generalities.

It has been found feasible to use women in the greatest number where manual dexterity and repetitive performances are important factors. In tearing down and assembling complicated molds for plastic parts women have proved exceptional and maintain really amazing speeds over extended periods of time.

It is important in training to put the nomenclature of machinery into everyday terms with which the average woman is familiar. For example, in talking about the intake and outlet valves on a compression molding press, one instructor found that it stuck in the woman trainee's mind better when he likened these two valves to the hot and cold water faucets on sinks. He thus got away from the highly technical sounding words "intake and outlet valves." He told the trainee to think of the intake valve as a hot water faucet and the outlet valve as a cold water faucet. Placing her hands upon the controls, he said, "Now when you open one, the hot water faucet, you close the other, the cold water faucet; and when you open the cold water faucet you close the hot water faucet." After doing this several times, he again started speaking of them as intake and outlet valves, gradually leading her from the familiar faucet idea to a point where the words "intake and outlet valve" were just as familiar, through the association. This may seem like a simple illustration. The great majority of the problems are just as simple once a solution has been reached and more than anything else, the association of the unfamiliar with the familiar results in rapid training.

A surprising number of colleges have educational training programs of an industrial nature. Many high schools are running special night courses for factory workers, enrolling women for such subjects as blueprint reading, drilling, mold and tool design, and the use of various types of equipment such as lathes, drill presses, millers, hobbers and other machine tools.

Certainly any company in the plastics industry should take advantage of these courses. Whenever they are being given in a community near the plant, companies should try to have a part of the course angled toward instruction in the methods of handling plastic materials, molding, laminating and fabricating, with emphasis on the kind of work in which the individual plant specializes.

The foreman is the key person in the training of women and can make or break a program of hiring women. Management should by all means consult the foremen in the various divisions—molding room, tool room, finishing department, etc. —before hiring women. This holds good especially for plants where women have not been used previously. The foreman should be taken into the confidence of the management as to the need of replacing men with women, should be asked for suggestions as to the best methods of training, should be told to try and get the full cooperation of the other employees and should be impressed with the fact that the very existence of the business could easily depend on whether or not he were successful in training the new women employees.

Working conditions for women

This problem is perhaps the most perplexing to employers who have not hired women previously. According to the Women's Bureau of the United States Department of Labor, plant management should guarantee to women on both day and night shifts the following working conditions:

A half-hour lunch period with opportunity for a hot, nourishing meal.

Best possible lighting and ventilation arrangements in accordance with the most scientific developments.

Wherever possible, seats adjusted to the worker and her work, to do away with constant standing.

Safe work clothing and all essential accessories in the way of caps, goggles, gloves, shoes, etc.

All safety precautions. Use of the most approved methods and devices to protect women against every industrial poison to which they may be exposed, against hazards of handling explosive materials, and against lifting too heavy weights.

Adequate first-aid equipment and medical department.

Adequate and conveniently located washing, drinking and toilet facilities.

Adequately equipped and staffed lunchroom, dressing room and rest room.

All within-the-plant training of women and supervision of their work to be done by persons well qualified to handle the particular needs and problems of women.

Careful supervision of women workers from the viewpoint of personnel policies by a competent employment executive, preferably a well-qualified woman.

Any employer who runs up against particular problems in hiring women for the first time may find it helpful to communicate with the Women's Bureau of the Department of Labor, Washington, D. C., who will advise individual employers as to occupations, standards, policies and procedures to promote the efficiency of the woman worker and to safeguard her health.

Another problem which is not exactly one of working conditions but nevertheless closely linked thereto, is that of transportation of women to and from plants. With gasoline rationing becoming increasingly stringent and other methods of transportation jammed, a real problem is present here. In addition to this, many factories are located in what women regard as "tough districts." Employing women on night shifts in neighborhoods like this makes adequate transportation mandatory.

A large eastern molder has found that employment of women for night work in his plant has been made much easier since the company adopted the policy of guaranteeing a woman's transportation to and from the plant prior to hiring her. The seemingly unimportant phrase "prior to hiring" is in fact of prime importance. The same company had found that a vague assurance that "a way will be found to get you back and forth to work" did not have the desired effect of comforting potential women employees.

Another important point in hiring women is to pay equal wages for equal work. This is not done in every plastics plant. In many cases there is a differential between the rate of pay for women and men on the theory that the man is the main provider and head of the family and thus is entitled to higher rate of pay than a woman. In labor shortage areas, such differentials are almost certain to cause trouble because the women feel they should be paid the same amount of money for doing the same job. In areas where there is an abundance of female labor, the pay differential will not generally create any difficulty in hiring women, although it does sometimes create friction after the women start to work, resulting in slowed down production and less satisfactory work by the women. Where a plant has adopted the equal pay for equal work principle, it is important to explain any apparent differential. In many cases it has been necessary for molders to resort to much more mechanical and semi-automatic molding equipment. Because of this change in equipment, new job classifications have been created. In such cases, the women are not taking over jobs identical to those performed formerly by men, and so will not draw the (*Please turn to page 138*)

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11—*This battery of machines is entirely run by women workers who have proved at least as good as the men who formerly made the plastic molds in the same tool shop*

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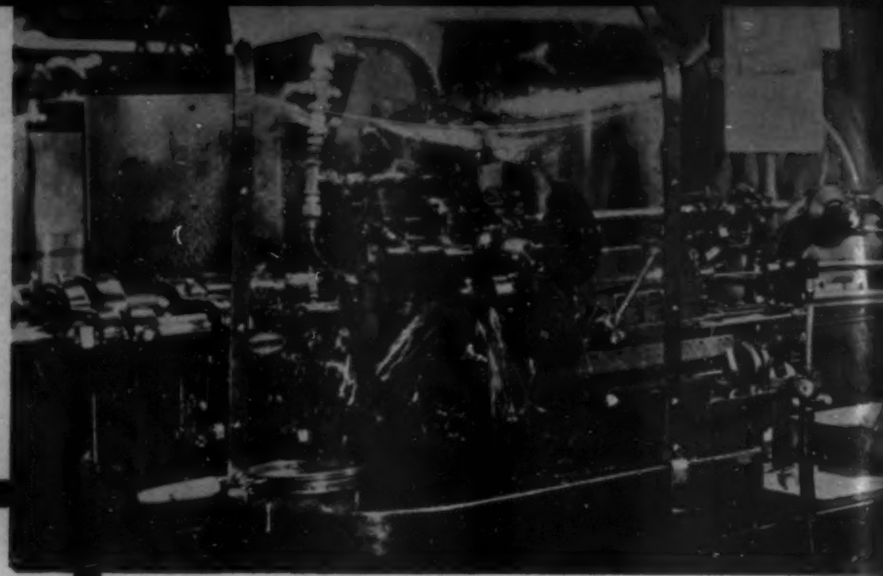

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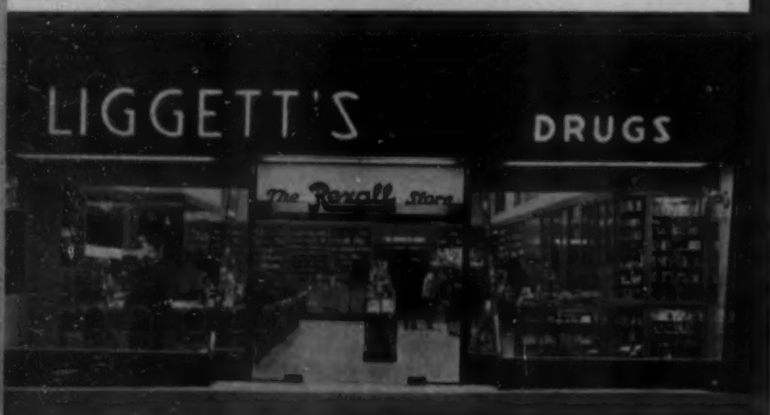
Plastics in Review



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1 One . . . two . . . breathe deeply. The attachment on the gentleman's nose is a McDonald Clear-Vue Dustfoe Respirator, worn for protection against dust. All metallic parts in this victory model have been replaced with transparent Fibestos which, in addition to being light in weight, enables the wearer to check his filter without removing his mask. All parts are replaceable and easily sterilized. Molded by Plastic and Rubber Products Co. for B. F. McDonald Company

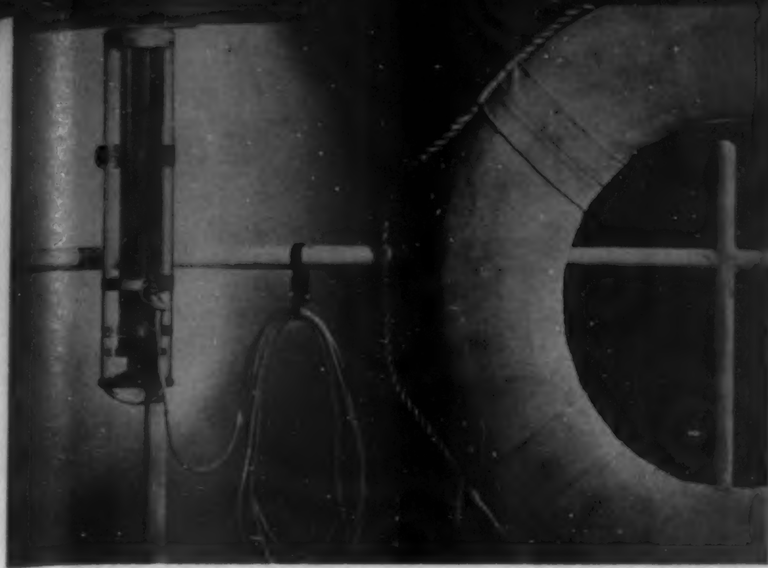
2 Splashing and loss of lubricating oil in metal processing operations are brought under control by fitting automatic screw machines and turret lathes with shields of tough, transparent Lumarith. Light in weight and flexible, shields may be fabricated from sheet stock and are easy to install. The action of the oil against the shield tends to keep its surface clear and the oil may be taken from the drip pans into which it flows and filtered for reuse

3 Little doubt can there be as to just where you are with a sign as clear as this one in front of you. The letters are made of 2-in. thick Plexiglas, an excellent medium for edge-lighting and a good weather and heat resistor. Superimposed about 1 in. away from the shop's marble facia, they are illuminated with imbedded Neon lights. Letters are fabricated from rod by House of Plastics

4 A check on the accuracy of fixed gun sights calls for a sight level bracket. Pal Tool Co. has molded this one of Durez for Winkley Artificial Limb Co. In addition to the saving of metal, the conversion to phenolic has reduced the weight of this device and speeded up production. Molded to exact tolerances, the parts of the bracket need no finishing operation other than the removal of flash before assembling to form the completed unit

5 An ingenious bombsight, designed for light planes that embark on hedge-hopping forays, has been brought to light by Inventor Norman Greene. Showing excellent precision in tests at 400 ft., the device employs a pendulum to maintain the perfect right angle to the ground so essential for accurate bombing. Made of scrap metal, the inexpensive device has a calibrated dial of transparent Plexiglas which offers lightness, weather resistance and permanency of dimensions. Here the inventor, designer and fabricator is squinting down his bombsight

6 Clearing the seas for United Nations' convoys, ships of the Coast Guard and Merchant Marine are equipped with cylindrical electric water lights to avoid the danger of an open flame in waters too often slicked with oil. Constructed for emergency use, the light is encased within a container and dome molded of lightweight "Lucite," whose water-resistant properties serve to protect lamp and batteries. The light illuminates automatically upon hitting the water; is kept upright by a weighted base



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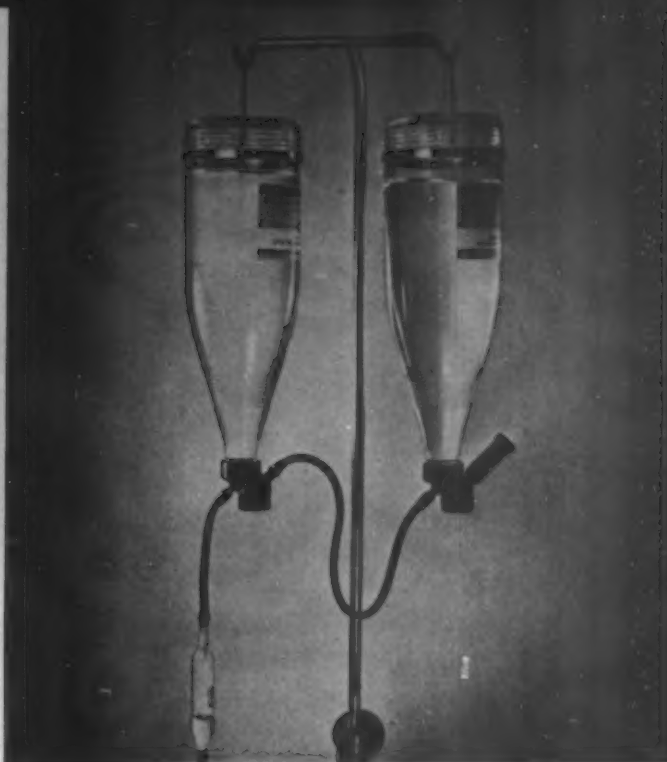

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7 The special water- and chemical-resistant qualities of molded phenolic material have been embodied in a Bakelite dispensing cap for a unit designed by Abbott Laboratories, and used by physicians in administering intravenous bulk solutions. The cap not only withstands the super heat and pressure of sterilizing but has the added quality of being non-corrosive, a valuable asset in permitting constant reuse of the cap. Molded by Chicago Molded Products Corporation

8 Sisal fibers impregnated with Durez compounds and resins contribute to the unusually high impact strength of the Co-Ro-Lite flap indicator and antenna guides used in modern aircraft. Due to its extreme toughness and a density comparable to that of wood, the plastic is particularly suited to airplane applications. The fiber-resin combinations, by Columbian Rope Co., are pressed into tough sheets to facilitate press loading

9 Possible shortage of imported glass microscope slips for covering biological specimens mounted on glass slides has been adequately provided for by General Biological Supply House, Inc. "Turtox" plastic cover slips, made from transparent Vinylite sheet, are reported to be outselling the glass type by 50 to 1. They are also claimed to be superior to glass for examining aqueous mounts since they are practically unbreakable and optically accurate

10 The now unobtainable lithe bristles of the famous razorbacks of the Orient have been supplanted by a tapered Nylon bristle made by du Pont. The new plastic meets necessary requirements for a superior bristle: taper, resiliency, toughness, length and inertness to paint ingredients. Though both the natural bristle brush (right) and its Nylon counterpart were used under similar conditions, the difference in wearing qualities is apparent. Production at present is for the military only

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Aircraft from West Coast timberlands

by C. E. ROZEMA*

RECENT despatches from London tell of a new British bomber, the Mosquito, said by air officials to be among the fastest planes in any category and one of the strongest in existence. Armed with four cannon and four machine guns, powered by two Rolls-Royce engines, the Mosquito is of simple plywood construction which lends itself to widely dispersed manufacture.

Although no plywood bomber has yet come from a U. S. aircraft plant, training planes, cargo ships, transports and gliders are being constructed in ever increasing numbers of plastic-bonded plywood.

Plywood for aircraft construction is not a new development: many of the "crates" flown in 1917–18 were covered and reinforced with plywood. Although metal was later substituted for wood in many places, replacement has never been complete, and plywood is again meriting and receiving increased attention by the aircraft industry. Today's product is different in several respects from that used during—and for several years after—World War I. It also is very different from commercial plywood. In brief, aircraft plywood is manufactured to definite strength specifications; there are definite weight limitations; thicknesses are measured in thousandths of an inch, not in sixteenths or thirty-seconds; and close regulation of the thickness of the individual plies as well as of the finished panel requires the use of precision equipment and workmanship.

To produce aircraft plywood, carefully selected blocks called "cants" are chosen for cutting into vertical grain lumber and veneer. The veneers, selected for quality (which is much more strictly defined in aircraft than in any other grade of plywood), are arranged in sheets, and these sheets are then laminated with appropriate resin adhesives in heated presses. The product is plywood. If it meets all inspection tests, it is stamped "Aircraft grade," or "Approved for aircraft manufacture."

In the past, equipment for cutting the veneers and making the plywood for aircraft has been concentrated in the Midwestern, North Central and Eastern States. Naturally, then, woods conveniently available to this equipment have been used to the almost complete exclusion of such West Coast species as spruce, fir, hemlock and pine—although spruce lumber and, to some extent, veneer, have long been accepted for use in airplane construction. Even now we find that too few West Coast lumbermen are "aircraft minded," with the result that the amount of aircraft grade raw material—logs and cants—is rather limited.

Until recently, the proper equipment and the trained personnel and the "hardwood" species have been able to meet the industry's demands. Now, however, demand is exceeding supply. The difference between supply and demand is not limited solely to available equipment. The supply of aircraft quality hardwood logs is now at a point where consideration of other species, more remote from the cutting and pressing equipment, has become highly necessary in meeting today's and tomorrow's demands.

Consideration of woods to be found on the West Coast, particularly in Oregon and Washington, is a perfectly logical step. Equally reasonable is the question of why the logs or cants should be shipped 2000 to 3000 miles for manufacture into products which must, to a considerable extent, be again shipped to the West Coast. While it is true that West Coast species cannot always be directly substituted for the customary hardwood species, the differences are founded principally on the differences in density; and the industry is rapidly learning to accommodate itself to the "new" materials.

Equipment for fabricating aircraft plywood

It was inevitable that the West Coast equipment be carefully studied for suitability for the manufacture of aircraft plywood from woods available in that area. It was soon made evident that the equipment used for the cutting, drying, assembly and gluing of commercial plywood is not generally adaptable to the handling of the thin veneers required in aircraft grade plywood. Vertical-grain, sliced veneers are required, rotary cutting not yet being considered acceptable. Drying must be done with a control of temperature and moisture content not practicable in commercial plywood equipment. Because the

* Technical representative, Resinous Products & Chemical Co.

PHOTOS, COURTESY RESINOUS PRODUCTS & CHEMICAL CO.

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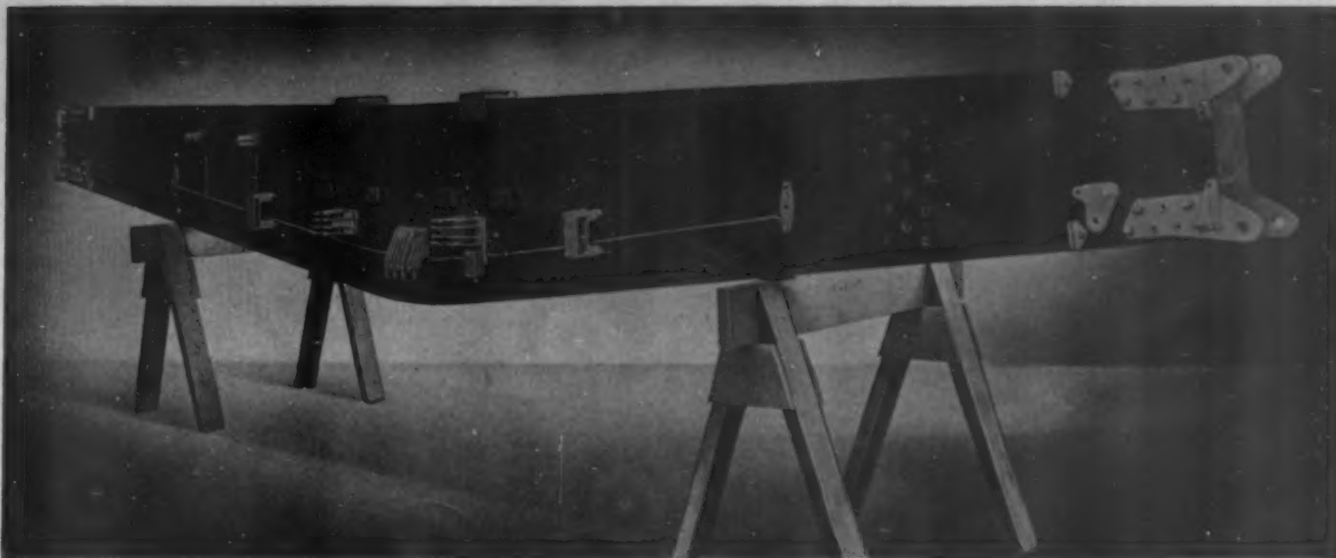
1—Lumber from the West Coast is finding increased application in plywood for aircraft. Manufacturing a laminated wood spar section of an AT-10 Beechcraft to engineers' specifications of weight, thickness, strength



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veneers are long (usually 8 to 16 ft.) and narrow (4 to 12 in.), they must be joined edge-to-edge to make sheets with perfectly fitted joints. Liquid adhesives cannot be applied to the very thin veneers without extreme loss through breakage, buckling and splitting. Many of the hot-plate presses do not have the requisite smoothness and flatness for aircraft plywood, in which the thickness tolerances are measured in thousandths of an inch.

Although in the Pacific Northwest there were four veneer slicers of suitable length, only two had been adjusted and used principally for cutting aircraft quality veneers. Now all slicers available in this area are prepared to cut aircraft veneers, and one more has been added through the establishing of a new operating unit. Drying equipment is even less adequate than slicing equipment. The same is true of edge jointers and edge-to-edge gluers; but this equipment is relatively more available and involves less investment than do slicers and dryers.

Hot-plate press equipment on the West Coast was not specifically designed for manufacture of high-precision aircraft grade plywood. Nevertheless, some of the presses are capable of meeting the requirements. We find, however, that the hot presses are already working at full capacity in most mills, producing much needed plywood for military housing, boat construction and many other very (*Please turn to page 134*)

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2—Aircraft plywood spar showing metal wing fittings, control brackets and engine cowl brackets in place. 3—To steam-bake plywood, it is bent around the form, wet and shaped and dried in 20 minutes. 4—Phenolic resin film interleaved between veneers before hot pressing aids plywood to withstand severe service conditions

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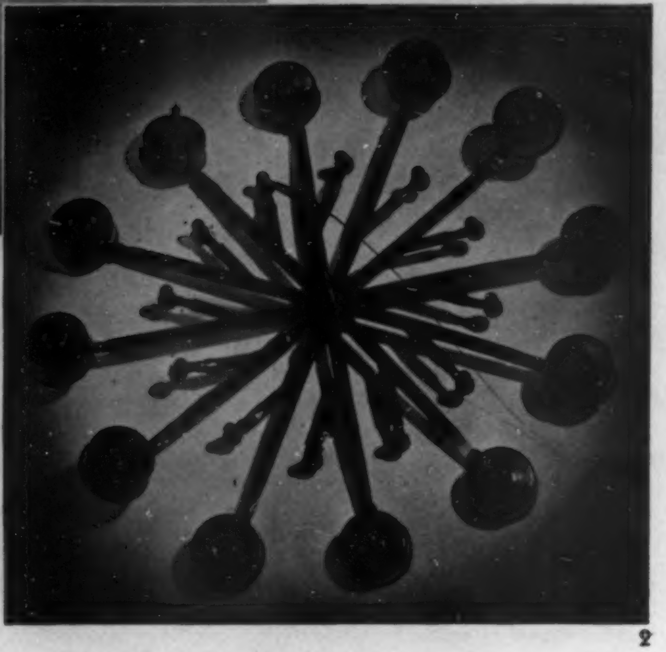
1—*Lighter fluid is tightly sealed in its bottle by a molded plastic bottle cap with tapering spout. Tiny threaded cap reseals the bottle when it's not in use.* 2—*Closures and reseal caps are molded 24 at one shot*



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Spouted closure

CONSTANTLY exposed to the elephantine humor of his friends is the man who carries a lighter. The ribbing he takes has a certain monotonous quality, consisting as it does solely of aspersions on his gorgeous (expensive) (swank) (trick) contraption because it won't work. He brings it forth with a flourish, snaps frantically—and nothing happens. This is usually because he has forgotten to fill the thing!

Pouring fluid into a lighter's tiny aperture without spilling takes a steady hand. It also takes a fluid container with a suitable spout. Until metal grew scarce, the makers of Energine lighter fluid packaged it in 3-oz. and 8-oz. blackplate cans furnished with spouts of lead. Of lead also was the thin film which sealed the spout until the purchaser pricked it with a pin, after which he resealed his can with a tight reseal cap which came with the fluid.

A new container for the fluid was not difficult to find. Like many another product formerly marketed in cans, it could very well be dispensed in glass, and a 3-oz. Boston round bottle in amber was selected for the purpose. Fixing on a suitable closure, however, was quite another matter.

To pour the highly volatile fluid from the wide neck of the glass bottle would be difficult; and to transfer it from bottle to lighter opening without considerable overflow would be impossible. To complicate matters further, fire regulations demanded that the container have a complete seal at the time of shipment. Obviously there would have to be found some sort of spout which could be tightly sealed, broken open without fraying the customer's temper, and securely recapped.

As have so many others, this manufacturer's quest ended when he discovered that plastics could do the job; and users of the fluid need neither waste nor spill when they fill their new Christmas lighters from the little amber bottle. Its glossy black thread-screw cap tapers to a slender upright spout which, when the bottle is filled and packed for shipment, terminates in a tiny tip. This seal the purchaser breaks off to expose the opening of the spout, for which a small friction-fit reseal cap is provided.

The molder, before he designed the combined cap and spout, experimented with handmade models in order that no feature to be incorporated in the closure should be slighted. For example, it was necessary to get proper clearance at the top of the spout so that the break-off tip would leave the aperture clean for free pouring of the fluid. Special attention had to be paid to the tapering of the spout so that the tiny recap would fit snugly.

Experiments were also conducted with various types of plastic material before a cellulose acetate was adjudged most suitable for this particular application. Tough, rigid, mechanically strong, it provides a closure whose spout won't snap off with an accidental knock. Dimensionally stable, the plastic cap won't expand and allow the fluid to evaporate, or shrink until the minute orifice in the spout begins to drip dismally instead of pouring. A protective liner designed for the cap is coated with vinyl chloride-acetate, which is resistant to the aliphatic hydrocarbons in the fluid.

A 24-cavity injection mold was built to accommodate both the cap proper and the small reseal cap in equal numbers (see Fig. 2). Since instead of unscrewing the caps the molder uses a stripper plate, mold temperatures must be closely controlled to avoid damaging the threads of the larger cap. Molding cycle for the closures is three shots per minute. The company's filled and unfilled orders total some six million, and the manufacturer of the fluid reports sales to indicate that his customers are in accord with his desire to conserve sorely needed metals.

Credits—Material: Tenite; liner coating, Vinylite. Molded by Plastic Engineering, Inc., for Cummer Products Co.

PHOTO, COURTESY POPULAR SCIENCE MONTHLY

Producing trench mortar shell fuzes

by W. S. LARSON*

THE trench mortar shell fuze is one of the outstanding examples of materials substitutions in ordnance equipment. Formerly machined of aluminum rod, these units are now transfer molded of cotton-flock-filled phenolic compound. The conversion represents the saving of nearly a pound of metal per fuze.

When the use of plastics was first considered, it was apparent that certain changes in design were necessary; however, both nose and body had to be interchangeable with their metal counterparts and had to house the same metal assembly parts. This created a definite limitation on the amount of redesigning which could be done.

The fuze was then reconsidered as a molded part, and improvements were made in design to facilitate the molding operation. The major change was broadening of certain tolerances so that the plastic could successfully be held to dimension.

A second aspect of the problem was that of the material to be used and the effect that service conditions would have on it. Experienced molders recommended that a cotton-flock-filled phenolic resin be used. A suggestion for using thermoplastic materials and injection molding was discarded because of the maximum operating temperature of 170° F. which ordnance matériel must withstand. Thermoplastic fuzes lost their rigidity at that temperature and did not operate reliably. This particular fuze does not have to withstand the intense stress which high velocity ammunition is subjected to, and medium impact material such as cotton-flock-filled phenolic will serve the purpose. In addition, the Ordnance Department specifies that the material must be physically stable between temperatures of $-40°$ F. and $+170°$ F., must not exceed a specified rate of water absorption and ash content and must conform to other of the Artillery ammunition specifications. To confirm their decision on the material, the Ordnance Department fired thousands of molded fuzes until they were completely satisfied that plastics could do the job.

A third consideration to be taken into account when changing to a plastic material was that of providing for molding problems and mold maintenance. This could be done only

* Engineering Department, General Electric Co., Plastics Dept.

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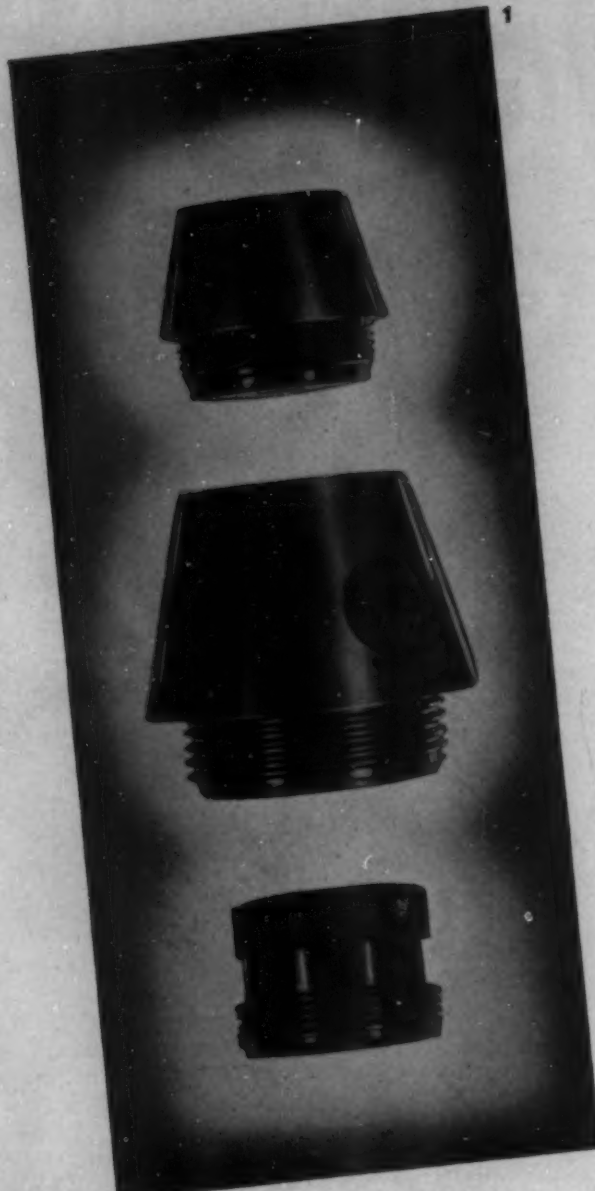

ALL PHOTOS, COURTESY GENERAL ELECTRIC CO., PLASTICS DEPT.

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within the limits which the drawing allowed, which left certain desired changes unaccomplished. When considering the redesign most applicable to molding, it is necessary to visualize the method of molding.

The next problem in engineering and planning which presented itself was the determination of mold dimensions. Although part tolerances had been broadened slightly, the molded body still presents a difficult production job in regard to dimensions. Following are listed some of the factors which must be taken into account, and which will change a part dimensionally:

1. Press size and pressure on compound.
2. Amount of preheat and flow of compound.
3. Wedge temperature and length of cure.
4. Compound shrinkage.
5. Length of time during disassembling, and effect of restraining pins.
6. Mold wear.

These factors were allowed for as well as experience and molding practice could dictate, and two molds were built to the dimensions finally decided upon. With these molds, several hundred sample pieces were made up and carefully measured. A study of these measurements then told which mold dimensions were to be altered, which were all right. The keynote of the entire production, form molds to finished part, has been precision.

The greatest cause of variation in these dimensions is the result of the springback in the molded part as the mold pressure is released. The springback may be as much as .050 in. in extreme cases, and cannot be allowed for within the tolerances. The condition is aggravated by having some of the dimensions released when the press is opened, while others are restrained by pins in the mold. This condition causes distortion at the points which are held in restraint.

This condition is most pronounced in parts which are molded under the highest pressure. The problem is compli-

1—*Three parts of molded trench mortar shell fuze, top to bottom: head, body and booster cup.* **2**—*Assembled fuze, whose function it is to make the shell safe until it has been fired.* **3**—*Threaded members and plain pins of wedge used in molding fuze body are disassembled and reassembled during each cycle.* **4**—*Body is molded in 2-cavity frame. Operator is about to blow pot slug off plunger.* **5**—*Machine and 2-girl team disassemble wedges.* **6**—*Body is cleaned to remove burr or fin.* **7, 8**—*On inspection tables, all six of the threads are accurately gaged to 100 percent*

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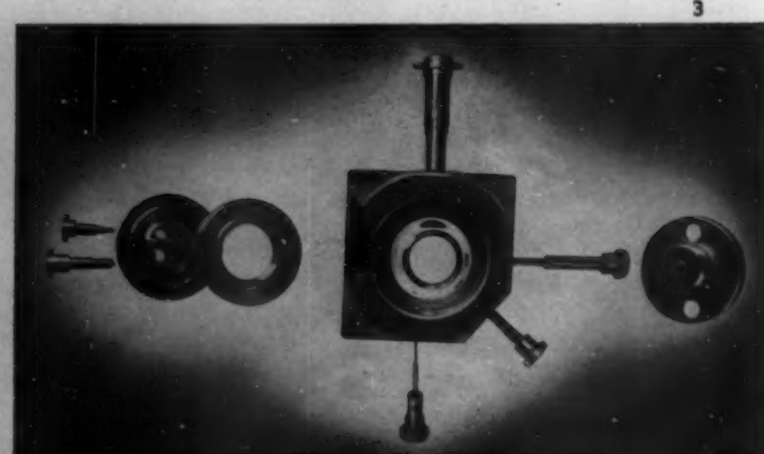

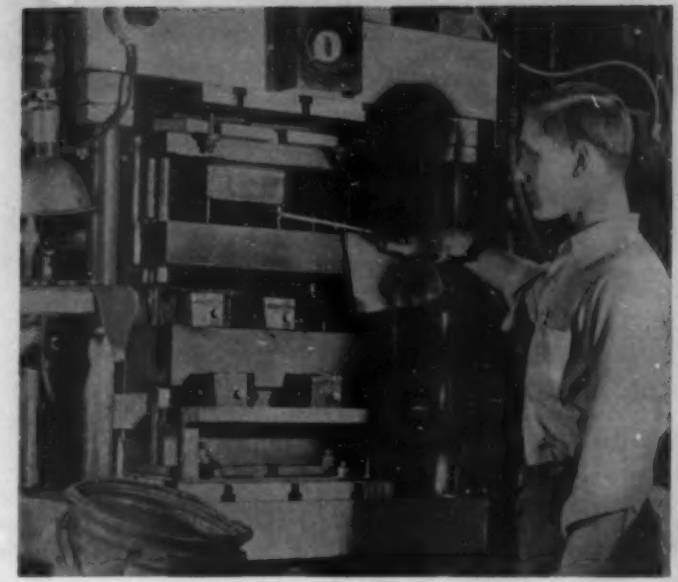

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cated by the fact that the flow of compound, the condition of preheat and the mold temperature are all variables which indirectly affect the pressure exerted on the molded part. In addition, these variables influence the shrinkage of the compound, which is a force tending to offset the effect of springback. The perfect balance and control of these variables are difficult to ascertain and hold. It has been helpful to standardize the flow of compound in a testing machine which records the closing rate of a test mold. Preheat and mold temperatures are then held as constant as possible.

Disassembly of the wedges is done by a disassembly machine and a team of two girls, as shown in Fig. 5. Here two units are shown, each unit serving one press operator and three presses. The three unthreaded pins are withdrawn by air cylinders actuated by the handles seen at the top right of the machine. The threaded side pin is unscrewed by a side spindle, the handle of which can be seen just between the two girls. The small top pins are unscrewed by the electric hand drill shown. The large bottom threaded plug is unscrewed by the machine and the large top threaded plug by hand. All loose mold members are then put in the tray shown on the corner of the assembly table; here they are readily accessible for the girl who assembles them. The complete cycle takes approximately $^1/_2$ minute per wedge.

Cleaning of the fuze body is complicated by the necessity of removing the smallest piece (*Please turn to page 146*)

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1—Completed assembly of bomb recorder frame showing continuous piano-type hinge which allows top to be lifted for insertion of reports. 2—Frame section after the straight knuckles have been bent into partially closed cylinders in a forming section. Beneath it are injection molded locking latches and pins with sprue and runners. 3—Sink runner and gate are visible as the molded part is removed from the machine

Molding a bomb recorder frame

WHEN a flight of our bombers takes off on a mission of enemy destruction, the bombardier is merely a passenger. It is only when the run on the target is about to begin that the bombardier takes complete command of the ship. For the short period of time which is taken for the approach and the release of the cargo of bombs, the bombardier sits with his eye screwed tight to the eyepiece of his bombsight and gives concise instructions to the pilot so that the target will be centered perfectly on the cross hairs of the bombsight.

Once the bombs have been released on the targets, two major duties remain for the crew: to bring the bomber safely back to its base; and to record the number of hits and near misses, the bombed targets and the apparent results. This information is of paramount value to the high command in deciding on all future action. Each bombardier is, therefore, equipped with a unit to hold his record forms—a sturdy portable frame and support. Until a short time ago this recording frame was manufactured from aluminum, and weighed $2^1/_2$ pounds. Since at that time approximately 250,000 frames were needed, it can be quickly seen that these requirements would have called for a total of 300 tons of aluminum.

A farsighted plastics molder, who saw that this situation presented a conversion problem, quickly made up a plastics model and submitted it for approval. The model passed the stringent tests of the Army Air Corps and the molder laid plans to go into production immediately. It was decided to hold the same wall sections on the production parts as had been used on the original model, the strength of which was considered ample. A single-cavity mold was engineered with several interchangeable plugs so that both the top half and the bottom half of this frame could be molded in the same mold merely by changing these plugs. Figure 5 illustrates the layout of these removable plugs, which are shown held firmly in line by two dowel pins. Also shown in Fig. 5 is the unique location of the guide pins inside the molded area—a clever departure from the normal practice, which permitted the utilization of a much smaller total mold area. It can be seen from Fig. 5 that, if these guide pins had not been placed as they were, the mold probably would not have fitted into an injection molding machine of the size now being used.

Figure 5 shows the frame parts after several machining operations have put them into condition for assembly. Two projections will be seen at the top and bottom of the part marked "T" which are not on the part marked "B" (Fig. 5). By changing the removable plugs in the cavity and changing

4—Each bombardier is given a unit to hold record forms on which he inscribes his hits and near misses, the bombed targets and the apparent results of his trip over enemy territory

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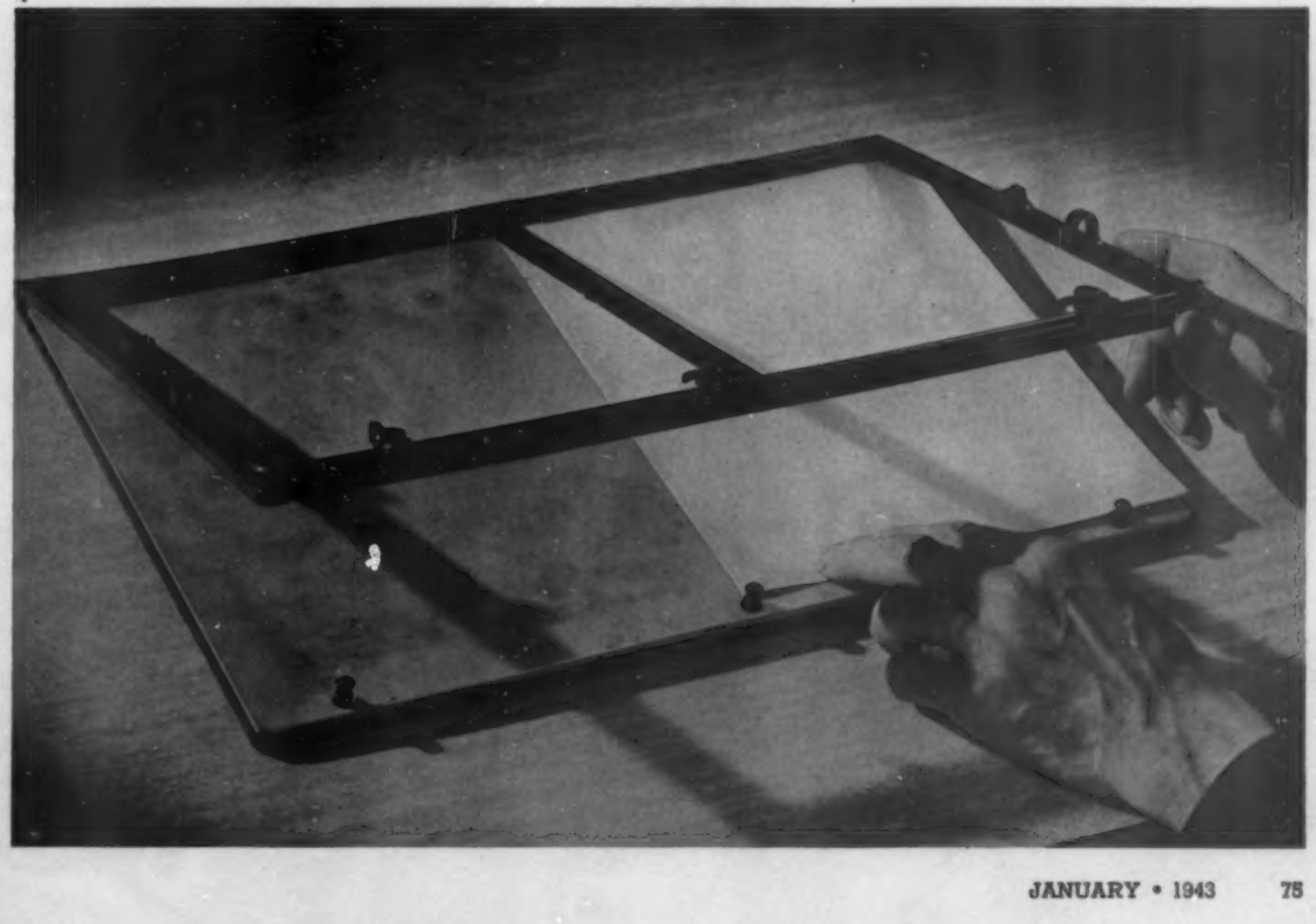

four pins in the force plug, these four projections, which serve as pencil holders, are molded.

Figure 5 also shows three runners with provision for two extra runners if necessary. It was found in production, however, that only one runner and gate was needed to flow the material completely around the entire section. As a matter of fact, this one gate is but .020 in. thick, and the molder states that he has had no difficulty whatsoever with weld lines and sink marks. Figure 3 which shows the molded part as it is being removed from the mold, also clearly indicates the sink runner and gate.

Figure 1, which is the completed assembly, shows a continuous piano-type hinge which permits the top to be raised and the reports assembled in the frame in such a manner that they will be securely held in place at all times. This piano hinge is formed in the usual manner by means of hinge knuckles and a hinge pin. The hinge knuckles are only partially formed in the mold—that is, with the exception of two outside knuckles, which have side-draw pins for forming the pinhole. The balance of the knuckles are formed at right angles in order to permit a straight draw from the mold. Immediately after the piece is knocked out of the mold, the straight knuckles are placed in a forming fixture and bent into a half-round, partially closed cylinder, which is the final shape. The frame section at the top of Fig. 2 shows the knuckles after the bending operation. This unique method of knuckle forming permitted the molding of a 17-in. piano-type hinge which in itself was one of the main reasons for the economical production of this part.

Instead of using a metal hinge assembled with rivets or drive screws to the two parts of the frame, the complete hinge and hinge pin assembly was made from the same plastic material. The hinge pin is merely a length of extruded rod which, when passed through the holes of the molded hinge knuckles, serves to complete the hinge assembly.

The balance of the plastic parts used in assembly include: three locking latches, three assembly pins for assembling the locking latches and three shouldered pins which are assembled into the bottom part of the frame and act in conjunction with the locking latches to keep this assembly in a closed position. These additional parts are made in two separate injection molds and are shown complete with sprue and runners just as they came from the mold (foreground).

There is one other part used in this assembly which has not been mentioned before, and that is a piece of plywood cut to shape approximately $^1/_4$ in. thick. When this is assembled into the frame it acts as a supporting table for the record forms upon which the bombardier jots down his notes (as illustrated in Fig. 4).

This molder, by his farsighted and ingenious design, has given our Army Air Force a completely workable and weight-saving unit for this job. As the plastic frame weighs less than $^1/_3$ as much as the aluminum frame, the saving may appear to be insignificant at first glance; however, as this is but one weight-saving item among many, it must be given due credit. At the same time, this conversion has released over 300 tons of aluminum for other non-convertible uses. *Credits—Material: Tenite II. Molded by Cruver Mfg. Co.*

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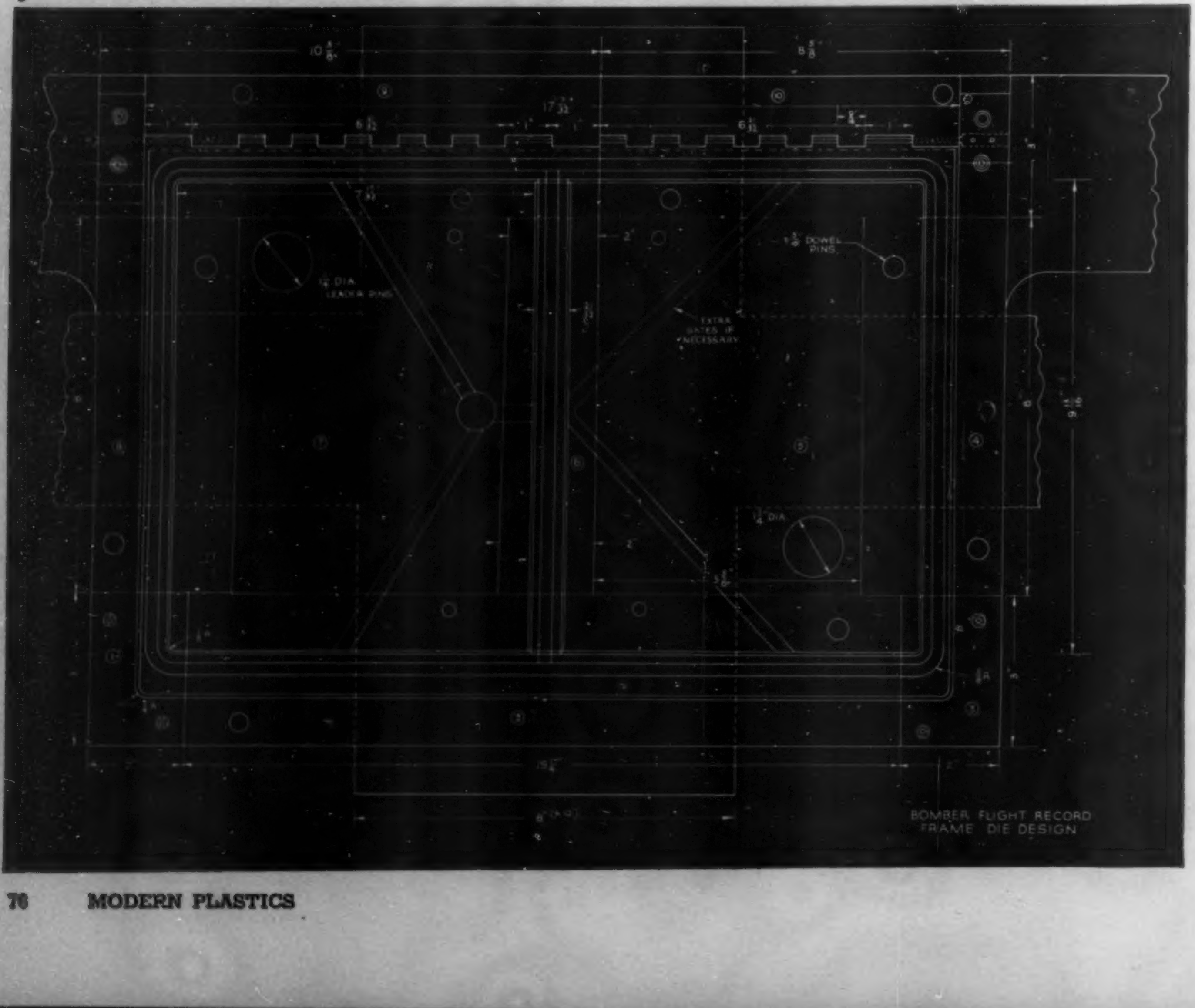


PHOTO, COURTESY PACIFIC LUMBER CO.

Steering with redwood wheels

A lumber company, a research organization and a manufacturer pool their facilities to convert the waste from the lumbering of rot-resistant California redwood into strong steering wheels for tractors and trucks

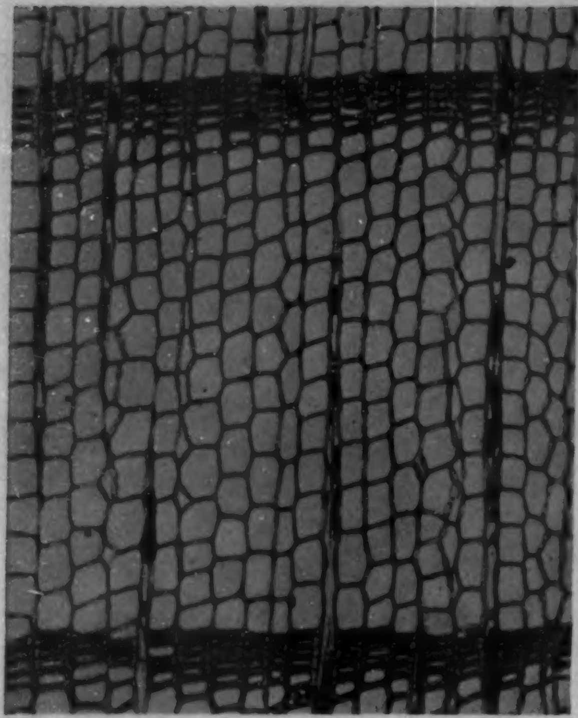
RUNNING on toward the Oregon-California border from a point about one hundred miles north of San Francisco and the Golden Gate, and near enough to the Pacific Ocean to have their high-flung branches swayed by the salty ocean winds, the mighty redwoods, *Sequoia sempervirens*, lift their heads two hundred feet or more above the forest floor and dominate the landscape. This redwood stand is found largely in Del Norte, Humboldt and Mendocino counties in California, in an area approximately 200 miles from north and south and 30 miles from west to east (Fig. 1).

Sequoia sempervirens in these stands is in general from 500 to 1000 years old, with some second growth in the logged-over areas. So resistant is the wood to rot that fallen trees have lain on the forest floor for hundreds of years, half covered with muck and mud, with large ferns or even other mature redwood trees growing over the fallen giants. And today, when the lumberman cuts the adult trees, the half-buried log is hauled into the saw mill, along with its freshly cut relative, where both go through the same process for conversion into boards, bridge timbers, etc., without showing much difference in physical properties.

One of the large operators in the field of redwood lumbering is the Pacific Lumber Co. of Scotia and San Francisco, California, whose plant at Scotia is equipped to produce the maximum amount of usable lumber from the trees being cut miles away on the California hillsides, and to apply new discoveries in the lumbering of redwood. Any lumbering operation involves wastes—the woods wastes such as limbs and branches and tree tops; the mill wastes, such as small dimensions, sawdust from the head rigs and trimmer saws. In their waste utilization program, the company has built up an entire operation centering around the use of the bark fiber for insulation, mattress filler, automobile seat cushions and, more recently, in combination with wool and other fibers for textiles.

Their awareness of the fact that redwood was being lost which might otherwise go into productive enterprise, coupled with a financial and technical interest in the property of redwood to resist rot and decay, led this company to interest themselves in the nature of the various components of the wood which characterize it as a permanent wood. After investigating the available research facilities of the United States, some five years ago the company turned to the Institute of Paper Chemistry of Appleton, Wisconsin, and there set up a long-time program of fundamental research and subsequent technical development. The Institute is a combined graduate school, research laboratory and library, established and maintained by a large percentage of the mills producing pulp and paper in the United States. Its personnel includes wood chemists and fiber microscopists, as well as more specialized workers in the fields of cellulose, lignin and the manufacture and utilization of pulp and paper products.

In the fundamental study at the Institute, the most important components of the redwood have been isolated and investigated. As these were identified, processes for their



PHOTOS, COURTESY INSTITUTE OF PAPER CHEMISTRY

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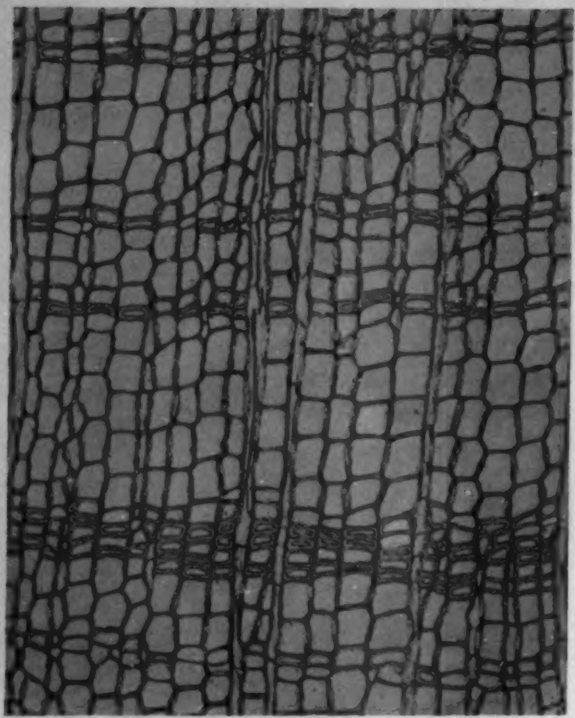

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2—Photomicrograph of redwood heartwood cross section before extraction of components used in molding. 3—Same cross section after extraction—both magnified 100 X. 4—Waste redwood slides down a long chute on its way to waste burner. 5—A conveyor carries the waste to a chipper which converts waste into chips for use in plastic pulp plant. 6—View of the volumetric feed from the plastic pulp plant showing pulp en route to transit line which carries it to baler. 7—To produce a steering wheel strong enough for use on trucks and tractors, a steel insert consisting of steel wire rim, 3 spokes and hub are combined. Here is continuous rim ring from machine with flying cut-off. 8—Spokes, cut to length are pressed into screw machine hub. 9—Holes are drilled through hub and spoke for dowel pins. 10—Dowel pins locking spoke into hub are pushed into place in steering wheel insert. 11—The three spokes are butt-welded to steel rim ring on automatic welder

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utilization were studied. The remarkable property of resistance to decay was found to reside, at least in part, in the water-soluble fraction of the wood, particularly in the tannin fraction. It was discovered that the wood-destroying microorganisms would grow on tannin-free sapwood, but would not grow on tannin-containing heartwood. Redwood tannin added to culture media normally used for propagating the wood-destroying organisms made such uninoculated test plates sterile. Further work with this tannin showed it to be of the catechol type and a hypothetical formula which will fulfill its chemical properties has been established.

One of the most interesting properties of tannin-bearing redwood is the fact that redwood flour can be molded under the influence of heat and pressure to give strong articles of good appearance but poor water resistance. An improved molding powder results when plasticizers and resin flours of the type of glycerine, furfural, etc., and hardening agents such as hexamethylene tetramine and formaldehyde are incorporated with the woodflour. Although of some academic interest, these combinations have never been pushed beyond the development stage due to certain inherent disadvantages.

In attempting to find ways of harnessing the thermoplastic properties associated with the extractives of redwood, which are distributed throughout the wood in the fiber walls and completely fill certain types of cells (see Figs. 2–3, a photomicrograph taken at the point of junction of redwood sapwood and heartwood, showing the distribution of certain of the extractions), it was found that the thermoplastic flow could be very greatly enhanced by cooking redwood chips with steam at elevated pressures for a period of seconds, then suddenly releasing the steam pressure—a process somewhat related to that used in making puffed grain cereals. Under these conditions, the chips are defibered and the extractives are made to react in such a manner as to increase their rate of flow under heat and pressure. The reactions occurring are somewhat obscure, but it is not entirely outside the realm of reasonable speculation that new resins may be formed through a combination of the phenolic redwood extractives with carbohydrates and their aldehydic dehydration products. At any rate, the pulp thus produced, which retains all but the gaseous decomposition products of the wood, may be molded directly to yield an article of good strength and appearance. This will be described later. Such pieces have tensile values of 5000 to 6000 p.s.i., notched Charpy impacts of 0.50, and flexural values of 7000 to 7500 pounds. (*Please turn to next page*)

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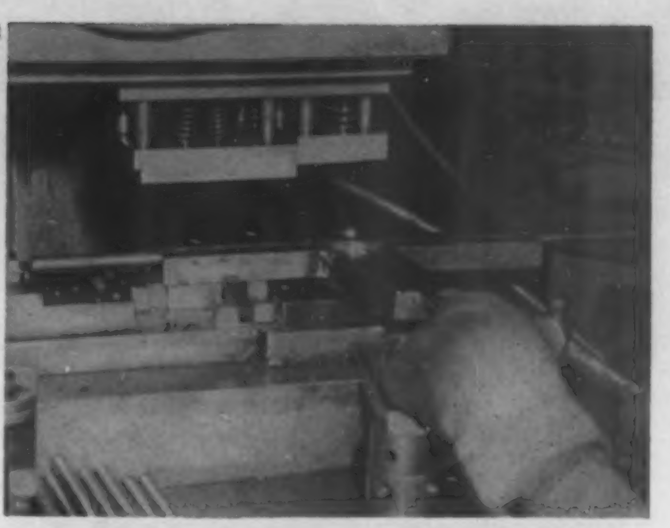

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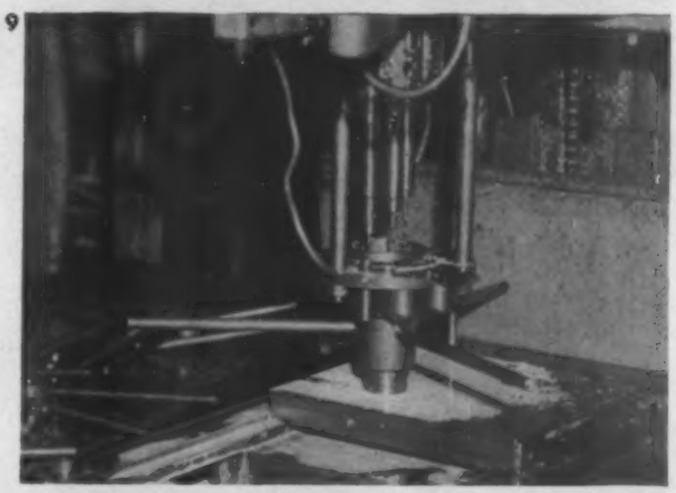

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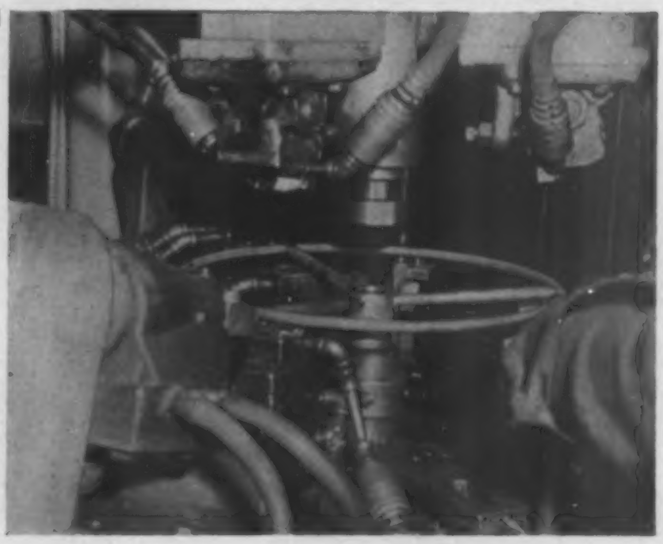

When the cooking conditions described above are followed in general, the reaction can be accelerated or made to follow other directions through the use of acid or alkaline reagents, or by the addition of a variety of resins or resinous materials (such as Vinsol, Gilsonite and other similar products, lignin and lignin derivatives, cumars, etc., to the chips in the digester.

The technical details of the above process were also worked out in the laboratories of the Institute. Over a period of four months, better than 300,000 lb. of pulp were manufactured on a semi-commercial scale in setting up the necessary production controls. A large part of this pulp has already found its way into the trade. Based on the findings at the Institute, a plant was designed and erected at Scotia, Calif., using wood and waste from the conveyors, and the plastic pulp produced is being shipped East in carload lots. This production can be stepped up very greatly with few changes in the operation, and the pulp may be expected to play an important role in the war effort since there is used for its manufacture only waste wood now being burned, water and steam (which can also be generated from wood waste).

The two agencies responsible for the production of the plastic pulp have been described above. A third was needed to bring the development out of the laboratory stage. The lumber company realized the importance of making available through productive channels a much higher percentage of the wood being cut, but it lacked the chemical experience and equipment necessary for devising ways of using the waste.

The research organization had the staff and the equipment necessary for laying the fundamental groundwork and directing the development into application channels, but its function is not one of putting a semi-commercial development on an operating basis. Here entered the third factor in this picture of cooperative research and coordinated effort—namely, an industrial organization alive to the commercial possibilities of the new development and technically able to realize them. This latter step is almost wholly due to the work of the Sheller Manufacturing Co., long a manufacturer of steering wheels, who used redwood plastic pulp as the basis for a new and improved wheel.

Redwood plastic pulp, produced as described above, is baled in Scotia and shipped directly to the manufacturing company, where it is defibered and mixed with small quantities of conventional molding powder components such as pigment and mold lubricant. For certain purposes the pulp

12—Left: Redwood pulp as received in bales after initial cooking operation. Right: Compounded pulp with resin, plasticizers, etc., thoroughly mixed. 13—Thermosetting plastic is cold molded around steel insert into preform which can be molded into complete steering wheel in 9 minutes. 14—Finished wheel, painted, is ready for shipment

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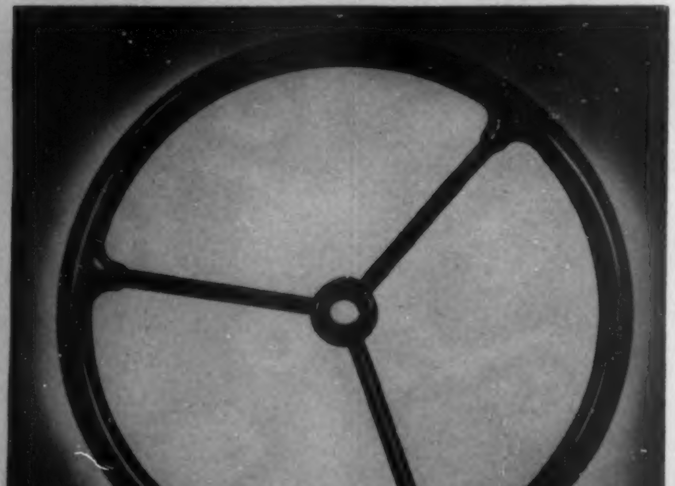

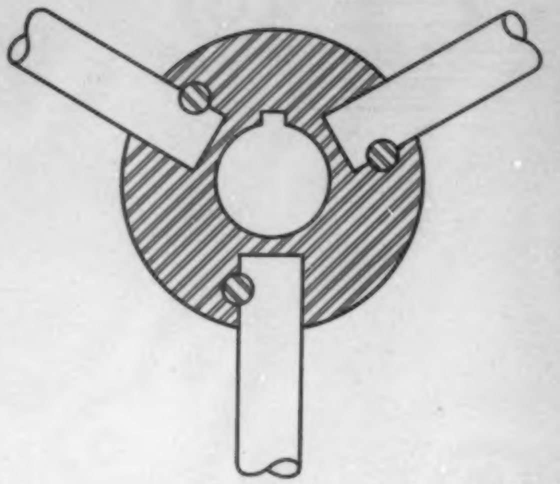

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15—*Construction of the steering wheel is shown in this drawing.* 16—*Conveyor system carries the wheels through final inspection department.* 17—*Either synthetic baking enamel or an air-drying lacquer can be used to coat wheels*

is used alone; for other applications shredded rags may be added to give increased impact; for still others, hardening agents may be added in small quantities. It may even be advantageous to incorporate small quantities of reactive chemicals such as furfural, phenol, aniline, or some form of lignin.

In the production of a steering wheel which must withstand the strenuous use that it is put through in the operation of trucks and tractors, the first prerequisite is the manufacture of a strong steel insert. The component parts of this insert are a steel wire rim, three steel wire spokes, and a substantial steel hub, all combined into one solid structure.

The steel wire for the rim is purchased from the steel mills in large coils, each coil weighing up to 500 pounds. The wire from these coils is first fed into an automatic straightening machine, after which it is fed through an automatic forming and cutting-off machine (Fig. 7). This machine can produce up to 1000 formed rims per hour. After forming, the rim is automatically butt welded.

The wheel hub is turned from round stock on automatic screw machines, and three side holes are drilled to receive the spokes. The spokes, having been cut to length on a wire-cutting machine, are then forced into the side holes of the hub by means of a punch press, which rams home the three spokes with such pressure that a very secure joint is secured (Fig. 8). An exclusive locking method is then employed which makes the joint between hub and spoke as strong as the wire itself. Three holes are drilled through the hub (drilling operation shown in Fig. 9) in a location which permits the drill to cut through a portion of the spoke as is illustrated. Steel pins are inserted in these holes and the ends upset in a punch press. This completes an assembly which is as strong as a one-piece job (Fig. 10).

The hub and spoke assembly is then automatically welded to the rim in a machine which welds all three spokes to the rim in one operation (Fig. 11). This assembly (U. S. Patent 2,304,945) is now ready for the molding operation.

The molding of a thermosetting plastic around the insert of a steering wheel is a very specialized job, and this company has found that a preform must be cold molded around the insert to get the best results. This operation in itself presents many problems, the two chief ones being holding the preform to the desired weight and holding the insert exactly in the center of the preform. A new and unique method for making this preform has been engineered by the company, but since a patent is now being applied for, details must be temporarily withheld. It is hoped that drawings and specifications of this perform die will be made available for publication in an early issue of MODERN PLASTICS.

Figure 12 shows the preform which has been cold molded around the steel insert and is now ready for the final operation of molding. The preform is loaded into the usual type of compression die and is molded into a complete steering wheel in nine minutes. This cycle is made up of six minutes curing time at a mold temperature of 350 deg. F., two minutes of chilling and one minute for ejecting (*Please turn to page 136*)

Plaskon gives "SEA LEGS"

You can't ask a battery of 16 inch guns to handle tableware with kid gloves.

That's why Plaskon melamine material now is being used for non-shattering American Navy tableware, to meet the specifications of the United States Bureau of Ships.

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Not only is this an important economy factor, but also one assuring safety and freedom from cuts.

Very low moisture absorption, and complete resistance to staining by foods and liquids, were conditions met by Plaskon melamine-formaldehyde,

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Design possibilities of Plaskon Melamine Molding Compound made it possible to produce a plate 8 inches in diameter with the same well capacity as a standard 9 inch crockery plate. The cup and saucer design has a unique non-drip and non-slip feature, which gives it a great advantage aboard ship: the cup nests into a depression in the saucer which is deep enough to allow the latter to be tipped more than 30° before the cup slips. This Navy tableware molded of Plaskon melamine-formaldehyde by Hemco Plastics Division, Bryant Electric Company, Bridgeport, Connecticut.

to Navy tableware ! . .

to assure attractive tableware under long use.

This new Plaskon melamine-formaldehyde tableware weighs about seventy per cent less than the crockery it replaces. When packed for shipment, it effects over 30 per cent saving of space. And due to the design possibilities of plastic material, the space needed aboard ship for storage of the new tableware is less than 50 per cent of that occupied by crockery.

Plaskon Melamine Molding Compound is non-tracking, highly-resistant to arcing, and has high dielectric strength. Write for further details, and describe any specific applications which you have in mind. The use of this Plaskon material is regulated by General Preference Order M-25. Plaskon Company, Inc., 2121 Sylvan Avenue, Toledo, Ohio. Canadian Agent: Canadian Industries, Limited, Montreal, P. Q.

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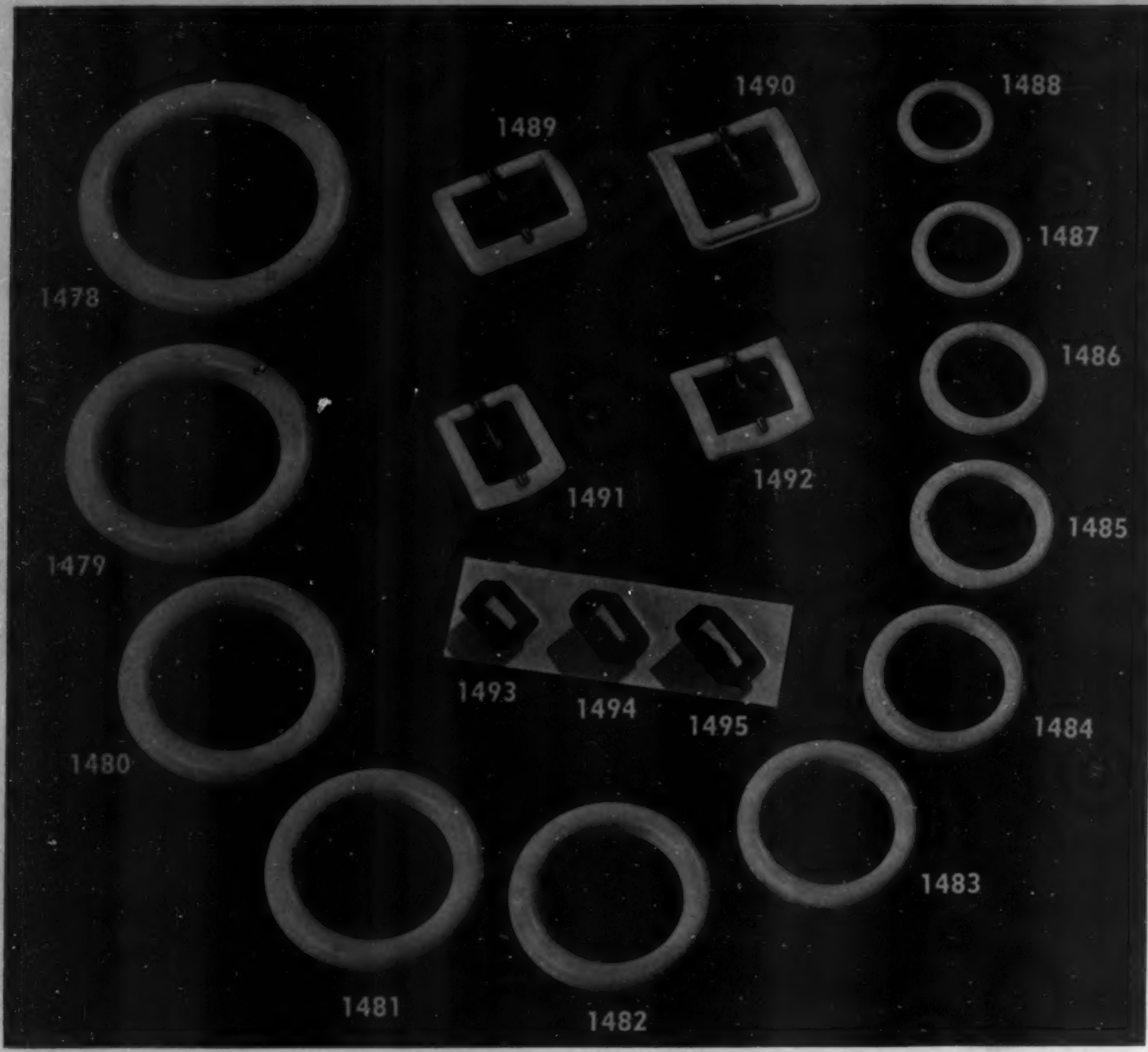

Stock molds

SHEET ONE HUNDRED TWENTY-SEVEN

Rings, loops, buckles primarily for use on or as saddlery and hardware trimmings, but adaptable for other purposes. White is standard color. Available without mold cost from stock molds, provided that restrictions on supplies, etc., have not limited current production. Address Stock Mold Dept., Modern Plastics, Chanin Building, New York, giving item and sheet numbers

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1478. Ring, 3 1/2 in. outside diameter, 2 1/2 in. inside diameter, 1/2 in. thick

1479. Ring, 3 in. o.d., 2 1/8 in. i.d., 7/16 in. thick

1480. Ring, 2 3/4 in. o.d., 1 7/8 in. i.d., 7/16 in. thick

1471. Ring, 2 1/2 in. o.d., 1 3/4 in. i.d., 3/8 in. thick

1482. Ring, 2 3/8 in. o.d., 1 5/8 in. i.d., 3/8 in. thick

1483. Ring, 2 1/8 in. o.d., 1 1/2 in. i.d., 5/16 in. thick

1484. Ring, 2 in. o.d., 1 3/8 in. i.d., 5/16 in. thick

1485. Ring, 1 3/4 in. o.d., 1 1/4 in. i.d., 1/4 in. thick

1486. Ring, 1 5/8 in. o.d., 1 1/8 in. i.d., 1/4 in. thick

1487. Ring, 1 1/2 in. o.d., 1 in. i.d., 1/4 in. thick

1488. Ring, 1 1/4 in. o.d., 7/8 in. i.d., 3/16 in. thick

1489. Buckle, inside dimensions: 1 1/4 in. wide, 3/4 in. long

1490. Buckle, 1 1/4 in. wide, 1 1/8 in. long

1491. Buckle, 3/4 in. wide, 7/8 in. long

1492. Buckle, 1 in. wide, 3/4 in. long

1493. Loop, inside dimensions: 5/8 in. wide, 3/8 in. high, 1/2 in. deep

1494. Loop, 3/4 in. by 3/8 in. by 1/2 in.

1495. Loop, 7/8 in. by 3/8 in. by 1/2 in.

Advances in plastics during 1942

General review*

by G. M. KLINE

PLASTICS had a rendevous with war in 1942. How well they proved their mettle during that first encounter with a market stripped of all decorative and novelty appeal and calling for cold utility and unfailing performance under fire will be evident from the facts presented in this review.

Materials

Statistics released during the year indicated that the production of plastics during 1941 was more than 57 percent greater than in 1940. Because of restrictions on manufacture and uses of most all types of plastics, the same rate of growth may not have been maintained during 1942. However, the statistics will probably show that the industry's production in 1942 doubled that of 1940, just as 1941 doubled that of 1939. The total production of resins reported in 1941 was about 438,000,000 lb. and that of cellulose plastics was 53,400,000, which together with unreported materials established an industry record at about the 500,000,000 lb. figure.[1]

Because of the difficulties in obtaining equipment for new plants, there was little activity in the marketing of new materials. One outstanding development, a thermosetting transparent resin which polymerizes without the evolution of water and hence is especially adapted to low pressure molding, was reported.[2] This resin is considerably more resistant to scratching than other types of transparent plastics. Its chemical identity has not been disclosed, so that it is known only by the trade name "Columbia Resin 39."

Several articles were published which described improvements in the formulation of molding compounds with various fillers and plastic binders. These pertained to compositions containing walnut shell flour,[3] styrene plasticized with chlorinated diphenyl for high-frequency work,[4] sisal fiber,[5] mica and lead borate,[6] cord-filled phenolic[7] and aniline-formaldehyde resin.[8]

The effect of restrictions in use of synthetic resins was reflected in the number of reports describing plastic compositions made from non-critical raw materials, generally of natural origin. These dealt with the use of lignin,[9–12] bagasse,[13] rosin[14] and related substances,[15, 16] redwood fibers[17] and miscellaneous hydrocarbons.[18, 19] The use of agricultural by-products as sources of raw materials for plastics was discussed in two papers.[20, 21]

The swelling properties of various fillers in water and alkali solution were reported.[22]

Molding and fabricating

Injection molding of thermosetting plastics made rapid strides during 1942. The basic characteristic of this new process is the introduction into the material of all the heat load required for polymerization prior to injection into the mold which shapes and sets the plastic. It is reported to provide parts of uniform density and excellent quality on fast production schedules and to be especially adapted to molding parts with inserts.[23]

Further progress was made in the utilization of low-pressure molding methods in the fabrication of relatively large parts for aircraft and other military purposes. Several reviews of the problems and advantages of this technique were published[24–26] and an important patent relating to the field was granted.[27] The urea-formaldehyde resins continued to predominate as the bonding agent for production in this field, but there was considerable activity in the development of phenolic resins which would be suitable for use at low temperatures and pressures. Reference has already been made to the adaptability of the Columbia resins to low-pressure molding.

The use of zinc alloys for casting molds which are suitable for short runs on plastic parts was described.[28] Availability of these molds at present is restricted to high priority needs because of shortages of the alloying elements, aluminum, copper and magnesium. A report appeared concerning the effects of annealing conditions on the hardness of mold steels.[29]

Applications

The normal market of the plastics industry was blitzed by the military during 1942. However, it was an attack in which the industry cooperated fully and the record shows a rapid and effective conversion of materials and molding facilities to production for war. Ordnance components molded of plastics included handles for pistols, bayonets and machine guns,[30] fuse parts,[31] ammunition rollers[32] and booster tubes.[33] Quartermaster supply items fabricated from plastics included helmet liners,[34, 35] whistles,[36] bugles,[37] skis,[38] and raincoats.[39] Chemical warfare services utilized plastics extensively in gas masks.[40, 41] The battle fleets employed plastics in navigation instruments,[42] wire and cable insulation,[43, 44] binoculars[45] and tableware.[46] Small landing craft and swift patrol boats were made of resin-bonded plywood.[47, 48] Goggles,[49] wire-reinforced flexible window enclosures,[50] parachute flare bases[51] and stirrup pumps[52] were among the miscellaneous war products in which plastics were used. The background of experience in these applications of plastics and the accumulation of

* Presented before the Rubber and Plastics Group of the American Society of Mechanical Engineers, New York, N. Y., Dec. 3, 1942.

results of experimental and service tests on various plastic parts can be expected to lead to an even more amazing array of diverse military applications of molded parts during 1943.

The aircraft industry utilized plastics on an expanding scale for many such parts which have become standard accessories. Reports of developments in masts,[53] dies for forming metal sheets,[54] fairleads,[55] pilot seats,[56, 57] radio loop housings[58] and propellers[59] were published. Plastic-plywood was employed in the construction of trainers,[60, 61] gliders[62, 63] and miscellaneous structural parts and accessories.[64–68]

Developments in plastic-plywood for use in building construction[69] and a variety of direct war applications[70–72] were described. Improvements in the resinous impregnating and bonding agents employed in this field were reported.[73–75]

Reviews were published pertaining to the applications of plastics in marine bearings,[76] water meter disks,[77] name plates,[78] closures,[79] collapsible tubes[80, 81] and printing plates.[82] Experimental studies on plastics for lighting fixtures[83] and dentures[84] contributed materially to better practice in these specialized fields.

There were two significant reports on the development of elastic plastics to replace rubber in some of its miscellaneous applications.[85, 86] More emphasis can be expected to be given to these elastic plastics in 1943.

Another noteworthy feature of the literature of 1942 is the occasional consideration given to postwar applications of plastics. These articles included discussions of shipbuilding,[87] home construction[88, 89] and design of industrial products,[90, 91] as well as postwar competition of plastics with metals.[92] A patent was granted to Henry Ford for an automobile body fabricated from plastics.[93] Further constructive planning of this sort during 1943 will enable the plastics industry to take the eventual transition from war to peace in a stride worthy of a progressive and growing industry.

Properties, testing, specifications

There was a gratifying increase during 1942 in the number of published papers setting forth the results of investigations of the mechanical properties of plastics. Many more engineering data of this type are needed to utilize plastics effectively in the military and postwar industrial fields. Committee D-20 on Plastics of the American Society for Testing Materials and the Rubber and Plastics Group of the American Society of Mechanical Engineers have been very active in promoting the preparation and distribution of these reports. The cooperation of all research and testing laboratories in the industry is needed to further augment our basic knowledge of the properties of plastics.

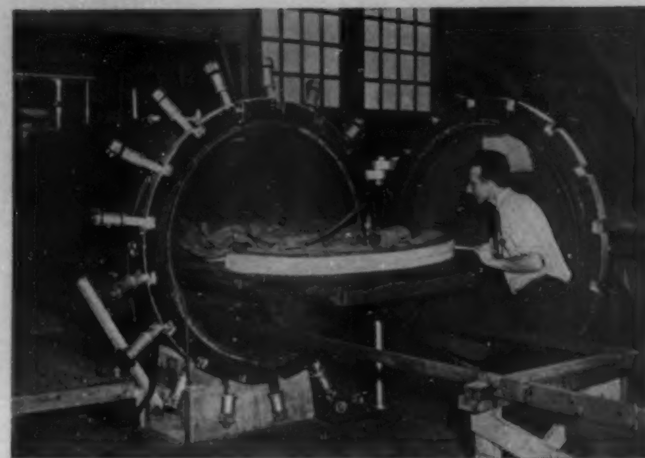
Four papers concerning various properties of plastics were presented at the 1942 annual meeting of the American Society for Testing Materials. One of these[94] gave data for the tensile, flexural and impact strengths of phenolic molding compounds over the temperature range of −80° to 225° C. (-112° to 437° F.). Another described experimental work on the determination of the mar resistance of various types of plastics.[95] Further work at the University of Illinois on the properties of cellulose acetate plastic was reported:[96] this portion of the investigation was concerned with the effect of time on the deformation of the cellulose acetate material when subjected to constant tensile loads for periods of time up to about 10 months. The effects of acids and alkalies of various concentrations on different types of plastics was determined by means of a shear strength test in the fourth paper of this group.[97]

Six papers relating to plastics were presented before the Rubber and Plastics Group of the American Society of Mechanical Engineers during 1942. The bearing strengths of paper- and fabric-base phenolic plastics were compared with birch plywoods after conditioning the specimens at 160° F., 70° F. and 50 percent relative humidity, and 70° F. in water, respectively.[98] Another report described the behavior of plastics under sustained vibrations from a new oscillatory-type testing machine in tension, compression and torsion.[99] The physical properties of new types of laminated plastics are tabulated in a third paper.[100] Information regarding the strength properties of plastic-plywood employed in the fabrication of aircraft structural parts is presented in another report.[101] The two remaining papers have not yet been published. One[102] presents information regarding the effects of heating for periods up to three weeks at temperatures ranging from 110 to 225° C. The other[103] supplements information previously published on the mechanical strength and fatigue properties of cellulose acetate, based on work conducted at the University of Illinois.

A number of other papers dealing with various mechanical properties of plastics were published during 1942. These related to the influence of temperature on the properties of polystyrene,[104] the effect of solvents on plastics as determined by reduction in shear strength,[105] impact strength,[106, 107] flow properties[108] and bending fatigue.[109]

Eight new tentative standards,[110] prepared by Committee D-20 on Plastics of the American Society for Testing Materials, were adopted during 1942. The titles of these are as follows:

1. Repeated Flexural Stress (Fatigue) Test of Plastics (D671-42T).
2. Test for Haze of Transparent Plastics by Photoelectric Cell (D672-42T).
3. Test for Mar Resistance of Plastics (D673-42T).
4. Long-Time Tension Tests of Plastics (D674-42T).
5. Terms and Descriptive Nomenclature of Objects Made from Plastics (D675-42T).
6. Method of Test for Compressive Strength of Plastics (D695-42T).
7. Method of Test for Coefficient of Linear Thermal Expansion of Plastics (D696-42T).
8. Method of Test for Water Vapor Permeability of Plastic Sheets (D697-42T).



PHOTO, COURTESY LANGLEY AVIATION CORP.

Low-pressure molding-development has been largely accelerated this year by the demand for large plastic-plywood aircraft structural parts. In the rubber bag method of molding plywood, special shapes are vacuum sealed in the bag and cured under heat and pressure in an autoclave

The Specifications Subcommittee of Committee D-20 prepared tentative specifications for phenol-formaldehyde, urea-formaldehyde, melamine-formaldehyde, polystyrene, cast methyl methacrylate, cellulose nitrate and rigid vinyl chloride acetate plastics. Preliminary drafts for cellulose acetate, cellulose acetate butyrate and laminated phenolic plastics were circulated for comment and are expected to be adopted as tentative standards early in 1943. At the request of several Government departments, a joint committee of representatives of the American Society for Testing Materials, the Society of Automotive Engineers and of the Army and Navy was organized in December as Section 10 of the A.S.T.M. Plastics Specifications Subcommittee to prepare specifications for the non-rigid plastics, including elastic vinyl, poly-acrylate and ethyl cellulose plastics.

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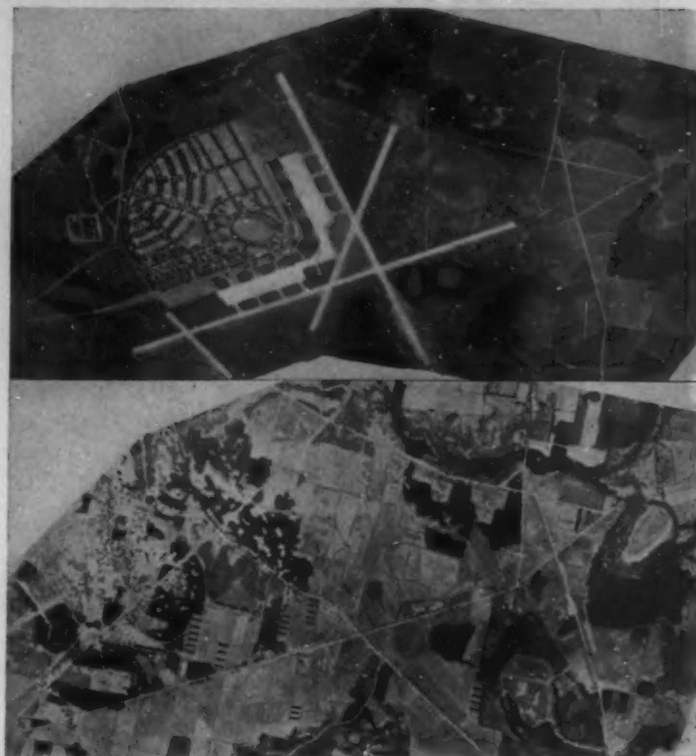
Surface coatings

by W. T. PEARCE*

MOST of the research activities and developments in surface coatings during 1942 have been directly related to war problems or essential civilian needs. Organizations such as the Scientific Section of the National Paint, Varnish and Lacquer Association and the Federation of Paint and Varnish Production Clubs have been large contributors to the solution of such problems. Numerous specifications were written for the many special finishes required.[1]

Visual deception or camouflage paints were developed for use on cloth,[2] buildings[3] and concrete or asphalt roads.[4] Aqueous emulsion paints were found to be most satisfactory for coating cloth.

Paints were required which would reflect infrared rays. These are used for protecting equipment stored in wooded and grassy areas and for preventing their location by photographic means. Methods for measuring the infrared reflectance of pigments and paints were designed and many types of pigments evaluated.[5, 6, 7]



PHOTO, COURTESY RESINOUS PRODUCTS AND CHEMICAL CO.

The effective concealment of such strategic points as this airfield is one of the wartime tasks of protective coatings. Here is the field as it looked originally and (below) after camouflage paint has done its work

Interest in luminescent paints increased. Many special pigments were introduced and tested in both fluorescent and phosphorescent types.[8, 9, 10, 11] Acrylic, polystyrene and other resin solutions were used as vehicles. Loss of efficiency under long exposure to ultraviolet light was studied.[12] Such paints may be quite useful during extended blackout periods for coating signs, markers, helmets, armbands and the like.

Uses of alkyd resins in paints for ships, trucks and tanks were extended. Alkyd resin emulsions were used more widely and specifications were issued for both interior and exterior paints of this type.[13]

Large quantities of phenolic resins and tung oil have been used in traffic paints. Due to the restrictions on the use of these materials, emergency specifications have been written which permit the use of more available materials. Methods for testing this type of paint were studied and special procedures for evaluating rate of drying, night visibility and wear resistance were developed.[14] Service tests were made on paints having natural resin vehicles.[15]

Many new non-phenolic resins and oils were introduced for use in place of phenolic resins and tung oil to give satisfactory fast-drying coatings. Ways of reducing the amount of chromates in rust-resisting primers were proposed.[16]

Work on new methods of testing was continued by the American Society for Testing Materials. Those adopted this year include abrasion resistance, consistency of house paints, and salt spray resistance.[17]

Some reports on fundamental researches were published. Studies were made of polymerization processes for drying oils, using esters of both conjugated and unconjugated acids.[18, 19] Adhesion of films to different metal surfaces, and effect of additions of a resin was reported.[20] Properties of several nitroparaffins and their uses with many classes of

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coating materials were investigated.[21] Effect of pigments upon oleoresinous film structure was studied and a large quantity of data secured.[22]

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Molds and molding

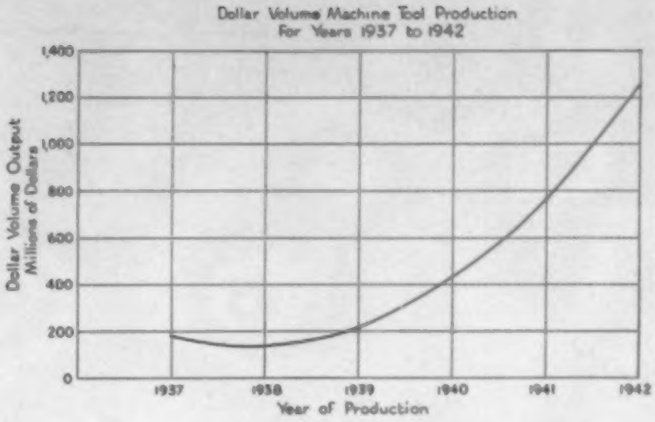
by F. B. STANLEY

MASS production, as practiced by industrial organizations in the United States, has at all times been head and shoulders above that of any similar group in foreign lands. Whenever a market has warranted large production, American industry has met the challenge and set up its production schedule so that output in every case was sufficient to meet the country's demand. During peacetime, this schedule could follow an increasing demand curve, with efficiency increasing and cost decreasing as production expanded.

However, during the past three years, this country has been preparing for and prosecuting the largest and most far-flung war that this world has ever experienced. It is a completely mechanized war, calling for the greatest machine production ever known to man. In reviewing the progress in the machine tool industry for the year 1942, there appears to have been but one noteworthy advance, and that is the fabulous amount of material that this section of American industry has been able to produce.

A glance at the chart (above) will show that the dollar volume output of this industry has in every year since 1939 approximately doubled the previous year's output. If the machine tool industry were a young industry, this increase would be of small import; but for a stable, well-established industry to show such an increase is little short of miraculous. Machines for the mass production of tanks, planes, ships and guns, have been completed rapidly to permit American industry to switch from producing its normal peacetime products and go "all-out" for war.

While it is true that by far the largest percentage of new



Plastics machinery manufacturers have followed the trend of all machine tool suppliers in increased dollar volume

machine tool equipment has gone into the various "conversion" industries, the plastics industry has had a conversion problem of its own. Of course, it has received some new machine tool equipment but, by and large, it has had to produce all of the new war production molds required of it with practically the same tool capacity it had in 1941.

In spite of terrific war production, the plastics industry has found time to develop new molding equipment and techniques which will go a long way in revolutionizing the methods now in use.

The Clem Shaw process for continuous injection (jet molding) of thermosetting materials has had a thorough production test.[1] The company has converted several standard injection machines to this process and has been in production for many months. Various sizes and types of phenolic pieces have been produced, some with large and complicated inserts, others with widely varying wall sections. No major difficulties have been encountered, and all of the molded parts have been successful applications for the war effort. Some of the advantages claimed for this process are: 1) Fewer cavities for comparable production rates, making a marked saving in tool cost; 2) minimum rejects on work involving close tolerances; and 3) fast production rates. The basic difference between this and other processes is that all the heat load necessary for polymerization is introduced into the material prior to injection. The mold merely shapes and

[1] MODERN PLASTICS, *20*, 41 (Nov. 1942).

Jet molding—a new method of continuous injection of thermosetting and thermoplastic materials—makes use of standard injection equipment converted with special units

PHOTO, COURTESY UNITED PLASTICS CORP.

sets the material. The nozzle of the unit is continuously cooled by water. When the plunger pressure is applied, extreme heat is momentarily generated at the nozzle and the material is thoroughly plasticized as it flows through the nozzle into the sprue, runners and die cavity. After the brief application of intense heat, the nozzle is at once cooled by the water, the plunger is immediately retracted and, consequently, the material does not set but remains plasticized and ready for the next shot.

Another major development has been the successful completion of a continuous extrusion machine for thermosetting materials. The details of this machine are still held secret, but it can be said that there is no limit to the volume of material that it will plasticize and extrude. This machine will also adapt itself to transfer molding, as it will hold a charge of material in a plasticized state for long periods of time. Details regarding this equipment may be available shortly for publication.

Turning to the thermoplastic molding field, a large single-nozzle injection machine, rated at a minimum of 22 oz. per shot, is now in production at one of the large steering wheel companies. Up until this year, it has been necessary to use multiple injection chambers for such large shots, but with the advent of this piece of equipment, there appears no limit to the capacity of single-nozzle injection machines.

Another plastics fabricator[3] has in full scale production a combination extrusion and forming machine which can produce hollow objects in one piece. This machine extrudes a tube which, in turn, is grasped by a forming die and blown into shape. This machine, with a set of rotating dies, has produced over 30,000 standard Christmas tree balls per 24-hour day.

A custom molder, using specially developed injection equipment, is now in full production on a thermoplastic job. The size of this mold is such that each shot, complete with sprues and runners, weighs 40 ounces. This is also shot through a single nozzle.

Refinements of standard extrusion machines have now made possible the extrusion of tubes with wall sections as thin as .006 inch. This equipment is being used in experimental production of collapsible tubes.

From the above it can be seen that the plastics industry is well abreast of the times and that, far from remaining static, it is constantly improving its methods and equipment.

Laminates

by S. W. PLACE*

THE expanding war program has placed a tremendous burden upon all manufacturers of laminated phenolics. The primary problem is one of obtaining the necessary raw materials in sufficient quantity. Then they must be processed into such forms as sheets, rods, tubes or molded shapes and, if necessary, machined into anything from a small ball-bearing retainer to a large high-tension bushing.

The demand upon all raw material manufacturers and processors so greatly exceeded the available supply of materials that a system of priorities has been devised to assure use of materials where they are most vitally needed. Laminated phenolics have replaced metals in many applications where their use did not result in lower strength or poorer performance of the finished article. In many such replacements, not only has performance improved, due in some cases to reduced weight, but the actual cost per part has decreased. One example is a cone pulley, formerly made from aluminum for a lathe manufacturer. Molded-macerated material cut the rotating weight in half and resulted in considerably better wearing qualities and longer service life.

Impregnated fabric, molded to shape for the lining of helmets, represents a vast wartime use for laminates. The fabric is cut to lie properly in the mold and is cured under heat and pressure. The U. S. Navy has adopted laminated phenolics for panel boards of warships where, on account of its high impact strength, it acts as insurance against possible fracture from heavy gun fire.

PHOTO, COURTESY BAKELITE CORP.

Impregnated sheets of fabric or paper cut to size are assembled for laminating between polished steel plates and then cured under high heat in multiple platen presses

"Compreg" wood is one of the newer developments this year, with many potential applications in aircraft construction. Wood is impregnated by soaking veneers $^1/_{32}$ in. to $^1/_{16}$ in. thick in a water-soluble phenolic resin for time sufficient to saturate thoroughly the wood fibers. This process injects as much as 28 to 30 percent resin into the wood. Cured under heat and pressure, the finished product shows high density, moisture resistance, and a tensile strength as great as 35,000 lb. per sq. inch. Propeller blades built up with several layers of these veneers are cured in five minutes by high-frequency heat treatment under presssure.

Impregnated glass cloth of the continuous filament type has developed tensile strength values up to 40,000 lb. per sq. in., and some special glass cloths have reached tensile strength values up to 60,000 lb. per sq. in. in the finished laminated sheet.

Much work has been done this past year on low-pressure

[3] MODERN PLASTICS 20, 46 (Dec. 1942).
* Synthane Corp.

molding of phenolic laminated materials. The use of low pressures, which may range anywhere from a few pounds up to 250 lb. per sq. in., makes possible the molding of large sections in inexpensive molds. Molds may be made from cast metals or even reinforced wood or concrete. Great savings are realized in mold costs, much time is saved in mold building, and less costly press equipment is needed. Formed sections may be made from phenolic-impregnated fabric. Layers of impregnated fabric may be cut to fit a mold or, if the mold is not of a shape to permit laminated construction, a given weight of macerated impregnated fabric can be poured into the mold and cured under heat and pressure. These materials have excellent tensile, flexural and impact strengths, approaching those obtainable under the high-pressure molding technique.

Cold-setting resins have also been used commercially for impregnating fabric. The fabric, in tape form, is wound over a cord or placed in a mold or forming fixture and allowed to set cold.

The new bag-molding process has been successfully used in a number of low-pressure molding jobs, where formed sections such as boxes, angles, cylindrical or other shaped objects are required. These objects, often large, may be formed with a minimum of tool expense and at low cost by this method.

Melamine resin is being used successfully as a laminating resin. It has an arc resistance superior to that of most phenolic laminated products. Melamine resin also makes a very satisfactory translucent laminated product or, used with an opaque filled white paper, provides a combination black and white panel stock suitable for engraving.

To sum up, some very promising developments in the laminating field appear to be taking place: first, the development of resins for low-pressure molding with proper flow properties at low pressures; second, the development of the technique, molds, methods and possibilities of low-pressure molding; third, improved technique in the processing of some of the newer filler materials such as glass fabric and wood; and fourth, new applications of laminated phenolics resulting in better performance, lower cost or both for many parts.

Phenolic resins

by L. M. DEBING*

DURING the past year, the use of phenolic resins for civilian applications has come practically to a standstill. However, the knowledge obtained in solving the problems presented by war necessities in the applications of phenolic resins has, no doubt, more than offset the knowledge that would have been obtained during an equivalent period of peacetime applications. Global warfare has made it necessary for the manufacturers and users of plastics to determine the serviceable temperature range of their products. The usual physical test data determined for plastics are inadequate as a criterion of actual service life. Considerable research has been carried on in developing and evaluating various fatigue tests and the rate of stress application. Examples are the study of impact testing, the behavior of plastics under vibrations, mar resistance of plastics, accelerated weathering tests, and loss of strength on prolonged heating.

Molders, laminators and fabricators of plastics have been faced with the problem of selecting the proper plastic from a multitude of such products to meet definite specifications. The manufacturers of plastics have given considerable aid in the selection of materials to be used. The Government has taken steps to simplify and correlate the various Federal specifications and standardize the procedure of physical testing. A data booklet has been compiled by the Plastic Materials Manufacturers' Association. The immediate objective was to provide Government agencies with complete information on the properties of plastics. Committee D-20 of the American Society for Testing Materials is now preparing specifications covering typical plastics commercially available. It is hoped that these efforts will result in a standardization which will greatly simplify the proper selection of plastics for a given application and also reduce the number of plastic materials to be considered.

* Monsanto Chemical Co., Plastics Div.

PHOTO, COURTESY MONSANTO CHEMICAL CO.

Phenol, formaldehyde and catalyst in measured quantities are mixed in a huge reaction kettle to form a molasses-like resin which is then solidified, and ground into molding powder—forming a wide range of plastic pieces

The improvement of molding techniques and the application of ideas to present-day needs is exemplified in the use of the expandable rubber force in the molding of the plastic helmet liner. The injection molding of thermosetting plastics continues to advance, and several commercial operations are now underway. The curing of phenolic resins by the use of infrared lamps and high-frequency currents has become a well-established practice. A novel application for cast phenolic resins is in the production of tools for forming dies and drill jigs.

The use of high impact strength molding materials has expanded considerably. New products having increased strengths and materials of improved performance have been developed. Electrical materials of low power factor and good dielectric fatigue properties enjoy a widespread application. The curtailed supply of phenol has stimulated investigation of new fillers which would permit the use of less phenolic resin in the production of molding compounds. Lignin-enriched fillers from wood and bagasse have received a great deal of attention. Fillers such as ground walnut shells and cottonseed hulls are being investigated along these lines. Natural wood resins and resins based on lignin in conjunction with phenolic resins are being reinvestigated in light of present-day needs.

Extensive war applications have been found for phenolic laminated products. New products have been developed

which greatly improve the strength properties of such laminates. The use of low pressures in preparing laminated products has been shown to be not only profitable from the standpoint of production but desirable from the standpoint of quality. Phenolic resins to meet these new demands have been developed.

The plywood industries make use of thermosetting resins for flat press panels, contour shapes (bag molding) and cold-setting adhesives for joint assemblies. No one adhesive is commercially acceptable for all three applications. The inert character of cured phenolic adhesives has prompted considerable research in this field in order to develop phenolic adhesives to satisfy the requirements of all three processes. The overall trend is to produce low temperature curing phenolic base adhesives. Blood-phenolic resin adhesives have fulfilled this requirement for flat panel work, but superior quality plywood can be produced with adhesives based on phenolic resin alone. All-phenolic resin base adhesives have also been developed for bag molding, to supplement the paper impregnated phenolic adhesive film which has been in use for some time. Equal progress has not been made in the development of phenolic cold-setting adhesives. There is considerable question as to whether or not the low pH requirements of cold-setting phenolic adhesives do not in time weaken the bond initially obtained. For this reason, the minimum pH of acceptable cold-setting adhesives is specified at a value somewhat above that required to satisfactorily cure cold-setting adhesives based on phenolic resins. Modified phenolic resins have also been developed as adhesives for making metal-to-metal bonds.

New experimental data have been presented to substantiate theories on the mechanism of the phenol-formaldehyde reaction and on the structure of the hardened product. The theory has been advanced, based on experimental data obtained on the hardening of phenols containing only two reactive positions, that cross-linking takes place through reaction of the phenolic hydroxyl group as originally postulated by L. H. Baekeland.

The appended list of references is a partial list of articles pertaining to phenolic resins which have appeared in the literature during 1942.

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"High Density Plywood," T. D. Perry, Modern Plastics *19*, 61–3, 110–14 (May 1942).

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"Plastic Bearings," D. Warburton Brown, Plastics *6*, No. 65, 333–39.

"Bearing Strength of Plastics and Plywood," James Bond, Modern Plastics *19*, 70–3 (July 1942).

"Marine Bearings," H. C. Irvin, Modern Plastics *19*, 33–4, 120 (April 1942).

"Resin-bonded Friction Materials," D. S. Bruce and R. T. Holstead, Modern Plastics *19*, 40–1, 94–8 (January 1942).

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"Lignin-Enriched Filler," John G. Meiler, Modern Plastics *20* 64–6, 128–9 (September 1942).

"Bagasse Molding Compounds," F. R. McElkinney, Modern Plastics *20*, 64–5, 136 (November 1942).

"Plastics from Hydrolyzed Lignocellulose," R. Katzen, A. O. Reynolds and D. F. Othmer, Modern Plastics *20*, 91–7, 122–4.

"High Impact Molding Compounds," C. H. Whitlock and R. U. Haslanger, Modern Plastics *19*, 70–4 (June 1942).

"Low Pressure Laminating," J. D. Nelson and G. F. D'Aleio, Modern Plastics *19*, 45–7, 122–3.

"Injection Molded Thermosetting Parts," A. R. Morse, Modern Plastics *20*, 41–3, 128–34 (November 1942).

"Ordnance Department Plastic Developments," E. T. McBride, Chem. Eng. News *20*, 849–50.

Urea-formaldehyde resins

by M. H. BIGELOW*

THE usual procedure in writing an annual survey is to list the outstanding achievements accomplished during the year. In past surveys of urea resins, it has been relatively easy to find these achievements in the field of molded urea resins. The war and the subsequent WPB General Preference Order M-25 has completely changed the picture, and we find the notable achievements of urea resins for the past year have been in the field of resin adhesives. We must not conclude that urea molding compounds have not or are not contributing directly to the war effort. This is not true.

Molded urea-formaldehyde compounds are being used in large quantities by various divisions of the armed forces. Molded urea resin buttons in blue, khaki and natural are specified for use by the Navy, Army and Marine Corps. They have been found, as would be expected, to stand the severe conditions incident to such use. Confidence gained through years of use of molded buttons has allowed the manufacturers of urea compounds to stand behind the use of buttons for Army and Navy purposes. Molded urea resins are used in navigating instruments. An outstanding accomplishment in this field is the recording drum of the Link bubble sextant. Molded urea materials are also used for the following items aboard ship:

Housings and parts for intercommunicating systems.
Housings and parts for radio communicating systems.
Lighting fixtures.
Tableware.
Color-coated control knobs.

* Plaskon Co.; now in Chemical Warfare Service.

In the field of aviation, molded urea material is used for color-coated microswitches, signal and warning light shields, illuminated visible instrument housings and panel boards, illuminated translucent name plates, color-coated control knobs, ignition parts, cabin lights and navigation light shields. Closely associated to aircraft use is the radiosonde, parts of which are molded of urea resins.

In the fields associated with the war effort to a lesser degree, but of direct interest since valuable metals are released for war use, fall such items as bottle caps, lighting fixtures, medicinal containers, electrical parts and a large number of other associated items.

In the field of resin adhesives, urea resins and urea resin copolymers have established themselves as important adjuncts to aircraft, marine and military items.

The outstanding achievement of the year is the development of low-pressure laminating techniques using low-temperature fusing copolymer resins. The base materials to be laminated may be any of the cotton textiles as well as mineral textiles, such as fiber glass. Compared to metals, these low-pressure laminates are stronger than steel and lighter than aluminum. Of course, such a statement is based on consideration of selected physical properties rather than on an integration of all properties. This low-pressure laminating process is now being actively investigated by the outstanding laminators in the country, and it can be stated that it is definitely a commercial item, not a laboratory process.

The use of resin-bonded wood for making skis for United States troops and of glued laminated wooden construction for beams and bent arches has been reported in MODERN PLASTICS. Beams and bent arches are being used by the Navy for making keels and other structural parts of the hulls of boats. These laminated structures are superior to the former oak timbers generally associated with marine construction.

An article describing in detail the use of cold-setting resin adhesives in the manufacture of aircraft parts appeared in the September 1942 issue of MODERN PLASTICS. This is a description of the well-known Vidal Process, which has saved the furniture companies and made them into supplementary aircraft fabricators. One needs only to review the several trade and technical journals to find that interest is definitely centered on molded plywood and plywood assemblies using urea resin glues of one form or another.

Urea resin coatings have been developed this past year to a point where they are now suitable for applications involving resistance to corrosive chemicals, to gasoline and to other high solvency naphthas. Already these two specific types of resins are not only available for use, but are being used. The food-canning industry, now deprived of tin, has available these corrosion-resistant resins. Steel cartridge shells, formerly made of brass and copper, can be adequately protected with similar lacquers. While differing only in a minor formulation, these same urea resins can be converted into films which are resistant to gasoline. Such resin coatings can be used on the interiors of plywood gasoline tanks and also in fabric gasoline tanks. Speaking of gasoline tanks, some day when it can be told, the urea resin people will be able to look back with pride to what they have accomplished in this field, now clothed in military secrecy. "Military secrecy" is the one reason why a survey at this time of some of the outstanding achievements appears to be incomplete.

Formerly solutions of urea resin for coating purposes were made with organic solvents. Today aqueous colloidal suspensions of such resins are finding uses for which the former resins were unsuited. Such colloids are replacing rubber latex, and also stiffening and binding agents for working gloves. They are used for making water-proof, fire-proof and fungus-proof, water-resistant cloth.

This year the urea resin people, recognizing the need for a low-cost molding compound, produced and now market Grade 2 material. This material, with the exception of color, is identical as far as physical properties are concerned to the older Grade 1 material, and, of interest to the molder, fabricates with the ease associated with Grade 1.

There have been several patents granted in the United States during 1942 on resin materials involving the use of urea-formaldehyde. A list of these follows:

U. S. Patents

2,256,253	Protein - urea - formaldehyde plastics	Oscar Neuss
2,255,995	Plasticizer for U.F.	Rex Cosgrove (Plaskon Co.)
2,255,998	Plaster of Paris-U.F. plastic	Howald & Meyer (Plaskon Co.)
2,258,130	Thioammeline-aminocompound	Bruson (Resinous Products)
2,260,033	U.F. molding compound	Kienle & Schreiber (General Electric)
2,261,084	U.F. condensation product	Hovey & Hodgins (Reichold)
2,263,447	Latent catalysts	Shepard (American Cyanamid)
2,263,661	Plywood panels	Walker (Celanese Corp.)
2,266,353	Coated tray	Carney
2,272,353	Casein-U.F. molding compounds	Ripper (American Cyanamid)
2,273,788	Alkyd-U.F. coatings	Olin (Sharples Chem., Inc.)
2,274,447	Catalyzing U.F. resins	Hodgins & Hovey (Reichold)
2,275,821	U.F. resin adhesive	Howald & Meiser (Plaskon Co.)
2,277,480	U.F. condensation products	D'Alelio (General Electric)
2,279,312	U.F. resins	Gutkin (Falk & Co.)
2,279,493	Amino resins	Ripper (American Cyanamid)
2,281,559	Urea resins	D'Alelio (General Electric)
2,283,740	U.F. glue	Klemm (Davis & Co.)

Plasticizers

by JOHN M. DeBELL*

PLASTICIZER plants worked at high capacity in 1942 producing the enormous amounts of materials needed for the war effort. While phthalates continued to fill the bulk of this need on account of their excellent performance, low cost and availability, there was also a trend toward extension of good plasticizers with less effective ones, and toward utilization of newer varieties based on vegetable oils.

Dibutyl phthalate expanded for protective coatings and molding powders; and large amounts of the less volatile dioctyl phthalate, dicapryl phthalate and ether alcohol phthalates found their way into the vinyl field for rubber substitutes in protective coatings and cements. In the early part of the year, the dimethyl and diethyl esters were sufficiently tight to cause a scurry for substitutes (mostly rather dubious) in the cellulose acetate molding field; but later, expanding supply of phthalic anhydride and more careful control of the ultimate uses eased the situation considerably.

Castor oil contributed considerably by use directly, as the acetylated ester, and by furnishing capryl alcohol and sebacic acid by conventional splitting methods. Azelaic acid from cottonseed oil was becoming available at the end of the year. Extender plasticization, however, did not realize its full possibilities on account of the fundamental defects of priorities systems: users who had good ratings were reluctant to

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extend, thus limiting the amount of solvent plasticizer for lower ratings.

Tricresyl phosphate suffered from skimpy cresylic acid supply and mounting demands for flame-proof cable. There is little possibility of any civilian supply for a long time to come.

Among other newcomers in the plasticizer field may be mentioned tributyl glycerol triphthalate; esters of polyhydric alcohols with four and six hydroxyls; and the diacid for Norepol, the rubber substitute from soybean oil developed by the Northern Regional Laboratories of the Department of Agriculture. Announcement was made in November that the last material appeared to be a plasticizer for zein, whose previous plasticizers had been markedly water susceptible.

In spite of this shifting around, and of the changes in supply, the main utilization during the year seemed to be that of the following standard combinations.

Cellulose acetate: dimethyl and diethyl phthalates; triphenyl phosphate for reducing flammability and sharpening the softening point; sulfamids except where light stability is required; methyl phthalyl ethyl glycolate and methoxyethyl phthalate.

Cellulose triacetate: cyclohexanyl stearate and higher phthalates.

Cellulose acetate butyrate: phthalates and tripropionin.

Cellulose nitrate (11 percent nitrogen for plastics): camphor, tricresyl phosphate.

Cellulose nitrate (12 percent nitrogen for lacquer): dibutyl phthalate.

Cellulose nitrate (12 percent nitrogen for artificial leather): castor oil.

Vinyl chloride: higher phthalates such as octyl, capryl or butoxyethyl; tricresyl phosphates for flame-proofing, low temperature flexibility and low loss on heating.

Rubber: paraffin, pitches, pine tar, cumar, dibutyl phthalate, dibutyl sebacate.

Vinyl chloride acetate: dioctyl phthalate, tricresyl phosphate for flame-proofing and esters of higher fatty acids.

Vinyl butyral for safety glass: dibutyl sebacate, triethylene glycol dihexoate and similar polyglycol esters.

Vinyl acetate: simple phthalates, ether phthalates.

Ethyl cellulose: phthalates, chlor diphenyl; castor and other vegetable oils for rubbery characteristics.

Regenerated cellulose: glycerine or glycols.

Protein materials: acyl glucosides.

Chlorinated rubber: diamyl and higher phthalates.

Cellulose esters

by J. W. HAUGHT*

THE production of cellulose ester plastics during the first six months of 1942, after which Bureau of Census figures were not released, showed an increase of approximately 25 percent over the same period of 1941 in spite of shortages of cellulose derivatives and plasticizers for civilian uses. Cellulose nitrate sheets, rods and tubes were produced to the extent of 8,513,000 lb. which is substantially the same as for the first half of the preceding year. This rate was considerably reduced late in 1942 because of allocation of pyroxylin.

Cellulose acetate sheets, rods and tubes produced remained almost constant in the first part of 1942. The production during the second half of the year suffered because of restrictions on some of the plasticizers.

Cellulose ester molding powders show an increase of over 30 percent up to July 1942. This increase is partly due to wider use of cellulose acetate butyrate molding powders, but Bureau of Census data do not list these products separately and, therefore, definite figures are not available. There were 20,937,000 lb. of molding powders sold in six months of 1942 as compared to 30,717,000 lb. for all of 1941.

PHOTO, COURTESY E. I. DU PONT DE NEMOURS AND CO., INC.

Cellulose acetate is pressed under heat into solid blocks which are then sliced into sheets of various thicknesses

Pyroxylin was placed on Government allocation in September 1942 by order of August 6, 1942, and production of cellulose nitrate plastics was greatly curtailed after that date. Of the cellulose nitrate plasticizers camphor was scarce early in the year but is now available and tricresyl phosphate has been on allocation since August 1, 1942. There has been no critical shortage of the other cellulose esters, but production of plastics has been below demand because of allocation of phthalate and phosphate plasticizers since August 1. Glycerol and citric acid esters have been used to some extent but no other plasticizers have been announced on any scale. Acetic anhydride was placed under allocation on December 1, 1942, and this may influence the supply of cellulose acetate during 1943.

The War Production Board issued General Preference Order M-154 on June 27, 1942, to classify civilian uses of thermoplastics into four groups. The effective date of this order has been postponed but the manufacture of articles in class IV was prohibited after September 1, 1942.

No new uses of outstanding importance have been developed for cellulose nitrate during 1942. In addition to the conventional uses such as fountain pens, pencils, toys, advertising novelties, optical frames, sanitary trade, and wood heel covering, cellulose nitrate has been used in an increasing volume for tool handles.

The largest war uses for cellulose acetate sheeting are for windows in trainer airplanes and gliders, and windshields for

* Plastics Department, E. I. du Pont de Nemours and Co., Inc.

motorcycles. Gas mask lenses have been stamped from cellulose acetate sheeting, especially from the continuous sheeting, since the optical properties of these lenses are better than of those made from molding powder and the lenses are cheaper. Cellulose acetate sheeting containing a fluorescent dyestuff which is activated by ultraviolet light is being used for lighting effects in war equipment where visible light cannot be used. The use of Louvreplas sheeting has been popular for indirect lighting. Black sheeting was used early in the year for spangles to replace those previously imported.

Cellulose acetate and cellulose acetate butyrate molding powders are becoming more and more important in the manufacture of war and essential civilian materials. Cellulose acetate butyrate and the molding powder made with cellulose acetate of high acetic acid content are used for applications requiring improved water resistance and dimensional stability. Among such uses are gas mask lenses, hose nozzle parts, pistol grips, color filters for blackout lamps, flashlight cases, first aid kits, gas mask Y tubes and valve parts, army combs, instrument name plates, stirrup pump parts, shaving brush handles, tooth brush handles, parts for airplane telephone sets, machinery shipping plugs, soap dishes, automobile door handles, linoleum edging, and lenses for airplane identification lights. The mechanical strength and the ease with which these products may be molded have made them extremely valuable as substitutes for metal, rubber and glass, or as materials for construction of articles for which metal and rubber are not satisfactory.

An interesting development in extruded plastics is the introduction of a collapsible tube made of cellulose acetate.

The regular cellulose acetate molding powders are used for the manufacture of articles such as gas mask lenses, spectacle and goggle frames, flashlight cases, combs, airplane repair part kits, faucet handles, air filters, toilet seat hinges and automobile hardware. The demand for acetate molded products in the automotive industry was greatly reduced during the past year but this was more than balanced by the need for thermoplastics in other production.

A number of patents have been issued in 1942 on improvements in the manufacture of cellulose esters and on plasticizers and stabilizers for the cellulose esters. Another patent, U. S. P. 2,292,516 to Hercules Powder Co., describes a composition comprising as the essential ingredient cellulose acetate having a combined acetic acid content between 56.5 percent and about 61 percent. Compositions of this type have been available commercially since early 1941 but have only recently been used to any extent. No entirely new cellulose esters have been introduced during the year.

As previously mentioned, cellulose ester thermoplastics may not now be used for nonessential civilian applications. However, they have in many cases been admirably suited to meet the requirements in the manufacture of essential war materials. Where the thermoplastics act as substitutes for more essential materials such as metals and rubber, they may in many instances continue in use after the war because of ease of molding or forming and because of the attractive appearance as well as serviceability of the product. Some of the nonessential products may be made of other substitutes during the war but it is expected that many of these outlets will again turn to plastics in the postwar period. The manufacturers of thermoplastics have constantly faced shortage in cellulose esters, plasticizers, solvents and coloring materials, but quantities sufficient for the war and most important civilian uses have been available and, it is believed, will continue to be available throughout the war.

Ethyl cellulose

by ARTHUR E. YOUNG*

ANY review of progress in the field of ethyl cellulose for the year 1942, our first war year, must take note of the difference in trend shown by the patent literature and other technical literature, respectively. The former is entirely the product of peacetime years and shows the trend of normal development. Current technical articles, on the other hand, inevitably relate to the uses to which ethyl cellulose is being put in wartime, and emphasize characteristics which had hitherto been partially overlooked.

During the year, ethyl cellulose was diverted from all but the most essential uses by General Preference Order M-175, which placed the product under complete allocation by the War Production Board.

An increase in airmindedness, due directly to wartime conditions, has brought the inherent high toughness and flexibility of ethyl cellulose at low temperatures, such as are encountered at high altitudes, to the forefront of attention. One manufacturer has introduced a new series of plastic molding granules designed expressly for improved properties at low temperatures.[1]

Because of its good impact strength at low temperatures, ethyl cellulose has been suggested for bonding cloth laminates to be used in making non-structural parts of aircraft such as fairings, spinners and streamlining shields.[2] The toughness, pliability and flexibility of highly plasticized ethyl cellulose compositions have been pointed out in suggesting these materials as rubber replacements in the production of such articles as gun covers, electrical tape, raincoats, hospital sheeting, surgical tape, wire insulation, coated fabrics and footwear.[3,4] Among the materials available for replacement of window glass in case of air raid damage is a clear plastic film of ethyl cellulose supported by an open textile mesh.[5]

Many advances in the technology of cellulose ethers have been recorded in the patent literature during the year. Further interest has been evinced in the possibilities of liquid ammonia as a medium for carrying out etherification reactions.[6–9] A mode of operation for reducing the quantity

* Cellulose Products Div., Dow Chemical Co.

Flexibility of ethyl cellulose film is indicated by this test. A block of dry ice resting on the thin sheet subjects it to low temperatures without causing cracking

PHOTO, COURTESY HERCULES POWDER CO.

of etherifying agent converted to by-products during etherification has been described.[10]

Limitation orders have restricted the use of ethyl cellulose sheeting in the packaging industry. However, a summary of the advantages of ethyl cellulose for making semi-rigid, drawn transparent containers has appeared.[11] Ammonium oleate may be used as stripping agent in aiding the removal of ethyl cellulose films from the casting surface during manufacture.[12] A transparent composite film has been described, one face of which becomes adhesive on application of heat and pressure. It may be used to protect printed matter from soiling.[13] A film consisting of alternate laminae of ethyl cellulose and polystyrene is said to combine the desirable characteristics of both materials.[14] Ethyl cellulose films containing dihydronaphthalene dimer are claimed to possess superior electrical characteristics and be suited as the dielectric for condensers, cables and coils.[15]

The compatibility of ethyl cellulose with a wide variety of coating and adhesive materials makes the possibilities of new and useful combinations for these purposes virtually limitless. New adhesive compositions disclosed in patents during the past year, and containing ethyl cellulose as a cohesive agent, include compositions for bonding cellophane,[16, 17] a binder for holding activated charcoal onto the graphite cathode of an air cell[18] and an improved chloroprene adhesive.[19]

Ethyl cellulose in combination with nitrocellulose and castor oil provides the basis for a new artificial leather coating which is claimed to be tough and flexible even at low temperatures.[20] The resistance of ethyl cellulose to the action of mild alkalies is utilized in making a lacquer for the interior of collapsible metal tubes for packaging liquid soap.[21]

The contamination of strong caustic solutions by metal from the walls of containers is said to be prevented by coating the interior of the caustic containers with a composition consisting of ethyl cellulose and an oil reactive phenol formaldehyde resin.[22] Clear coatings containing ethyl cellulose and polyisobutylene may be made if a mutually compatible plasticizer is used. The coatings are claimed to be both acid and alkali resistant.[23] Gas-proof coatings are described which contain polyisobutylene and sufficient ethyl cellulose and waxes to overcome the objectionable tackiness of the polyolefine.[24] The same characteristic of ethyl cellulose has been applied in overcoming tackiness in chewing gum.[25] A coating composition adapted to be applied to sheet material in the molten state comprises ethyl cellulose and a heat nonconverting rosin-modified alkyd resin.[26] A solventless composition containing ethyl cellulose and wax has been disclosed for bonding the plies of collars.[27] Compatibility of ethyl cellulose with waxes has also been taken advantage of in making a pencil for writing on transparent cellulosic sheeting.[28] Aircraft fabric tautening dopes are made from ethyl cellulose having an ethoxyl content lying between 42.0 and 47.5 percent.[29]

In the field of molding powders, an ethyl cellulose composition containing a minor quantity of a dicarboxylic acid anhydride is claimed to give molded articles of more than usual surface hardness.[30] Any tendency of ethyl cellulose injection moldings to show a laminated structure, as demonstrated by the appearance of "fuzziness" on abrading the surface is claimed to be overcome by correct choice of viscosity and ethoxy type of the ethyl cellulose used.[31]

An interesting application of ethyl cellulose in the art of textile printing is the use as a print paste of a water-in-oil emulsion, consisting of an aqueous solution of a dyestuff dispersed in a solution of ethyl cellulose in a hydrophobe organic solvent.[32]

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Vinyl resins

by HOWARD BUNN*

DURING 1942, the transition from peace to war applications for the vinyl resins and plastics was completed. In spite of increased production, the vinyls have become one of the more critical groups of war materials. The original M-10 order, allocating all vinyl chloride resins and vinyl chloride-acetates containing over 92 per cent vinyl chloride, went into effect back in April 1941. In 1942, this order was extended, first to include all vinyl chloride-acetate, and later, on October 10, all vinyl plastics including scrap materials. Demand by the armed services has become so great that, generally speaking, the vinyls are available today only for those essential applications where no other less critical material will serve.

Principal developments during the year came as a direct result of the rubber shortage. The use by the Navy of plasticized vinyl chlorides and vinyl chloride-acetates for wire and cable insulation was greatly expanded. At the same time, intensive development work was undertaken to perfect other rubber replacement applications. These efforts were highly successful, many diverse applications being developed for waterproof cloth coatings, flexible extruded tubings and molded articles. Next to wire and cable insulation, calender- and spreader-coated cloth has become the

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most important outlet for these elastic vinyl plastics. Military applications include Army raincoats, hospital sheeting, inflatable equipment, paulins, upholstery materials and many others. Another interesting application, from the point of view of severe service conditions, was the development by the U. S. Naval Observatory of a plasticized vinyl covering for aluminum binocular bodies.

Due to the extremely pressing needs for vinyl elastic plastics, very little vinyl chloride-acetate resin was available during 1942 for the production of rigid sheets and molding materials. The use of vinyl rigid sheet for calculating and navigating instruments of all types was expanded, however, due primarily to the excellent dimensional stability of the material.

PHOTO, COURTESY UNITED STATES RUBBER CO.

Highly plasticized vinyl coatings are applied to cloth by spread-coating or calendering for use in manufacturing durable, waterproof raincoats for the U. S. Army

In the protective coatings field, an important advance was made through the development of a new modified vinyl chloride-acetate resin which produces coatings with improved adhesion upon air-drying. This resin promises to increase the usefulness of vinyl coatings for maintenance finishes.

Vinyl butyral resins, which before the war were used almost exclusively for the production of safety glass sheeting, were also successfully adapted to rubber replacement applications during 1942. Principal uses have been as a replacement for rubberized cloth. By the addition of heat-converting elements, thermosetting vinyl butyral compositions have been developed which can be processed in much the same manner as rubber.

The production of vinyl acetate resins was curtailed in the latter part of the year due to a critical shortage of vinyl acetate monomer. Increased quantities of this important chemical were required for the production of vinyl chloride-acetate and vinyl butyral resins, while additional large quantities were needed for the synthesis of sulfa drugs for the Army and Navy. Great progress, however, was made in the use of vinyl acetate emulsions as replacements for latex and rubber. Other important war applications include the use of thermoplastic vinyl acetate resin adhesives to assemble metal and phenolic plastic parts.

Styrene and polystyrene

by R. F. BOYER*

THE year 1942 witnessed the gradual unfolding of the Government's synthetic rubber program with its consequent large demands on styrene monomer production. This event, together with notices of substantial reduction in the price of polystyrene,[1] the appearance of several new plastic materials based on styrene and the reporting of a considerable body of fundamental research, constitute the outstanding features of styrene development during the past year. Because styrene production was ahead of the butadiene and synthetic rubber plant facilities, substantial amounts of polystyrene were available throughout 1942 for essential civilian uses.

Monomeric styrene

Every conceivable process for making styrene monomer has probably been reexamined in the light of the critical raw material and constructional material situation. The dehydrogenation of ethylbenzene appears to dominate all other processes, with ethylene from alcohol coming into prominence as a raw material for ethylbenzene. Four companies have contracted to supply styrene monomer approximately as follows:[2]

Carbide and Carbon	25,000 tons per year
Dow Chemical Co.	91,200 tons per year
Koppers Chemical	37,500 tons per year
Monsanto Chemical Co.	30,000 tons per year

Operation of these plants, whose location is withheld, was scheduled to start between the fall of 1942 and late summer of 1943. This tremendous tonnage, many times the prewar output of styrene, promises a plentiful and inexpensive supply of polystyrene for postwar developments.

Numerous articles and patents have appeared on the history, properties and preparation of styrene monomer and its derivatives. An exhaustive investigation[3] of styrene monomer toxicity shows it to be among the less toxic of the similar aromatic solvents, and demonstrates that its penetrating odor gives ample warning long before toxic vapor concentrations are reached. Reports on the flammability[4] of styrene monomer and on its storage, inhibition and general properties[5] are valuable reference sources. An American article describes some problems encountered in the development of styrene monomer production in this country,[6] while an English account gives a comprehensive review of the chemistry of the various methods proposed for manufacturing styrene.[7]

The production of ethylbenzene from usym.-diphenylethane by catalytic pyrolysis,[8] and from xylenes by hydrogenation and dehydrogenation[9] was described. The preparation of styrene from chlorinated xylenes,[10] chloroethylbenzene,[11] phenyl ethyl alcohol,[12] and benzene plus acetylene[13] have been noted. Recovery of aromatic unsaturates from mixture of aromatics was accomplished with polyhydric alcohols.[14] The preservation of styrene monomer with sulfur forms the basis of a patent.[15] The preparation of trichlorostyrene,[16] tetrachlorostyrene,[17] and pentachlorostyrene;[18] of condensation products between styrene and diphenyl ethers;[19] of Diels-Alder adducts between maleic anhydride and substituted styrenes;[20] and of brominated

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styrene in liquid SO_2 medium,[21] all demonstrate the possibilities of styrene monomer in organic synthesis.

Polymerization

Dialkyl sulfates are suggested as polymerization catalysts for styrene monomer.[22] Polymerization under the combined action of oxygen, and ultraviolet light, followed by heat is claimed to give a high molecular weight polymer.[23] Styrene can be polymerized in zinc, magnesium and nickel containers to give color-free polymers.[24] A method for continuous polymerization,[25] and a means for removing the solvent used during solution polymerization,[26] have been the subject of patents. Alternate periods of quiescence and vigorous agitation are stated to be advantageous during polymerization.[44] Techniques for polymerizing styrene were reviewed.[27]

Treatment of polymer

Several schemes for removing volatile impurities from polystyrene are disclosed as follows: continuously dissolving polymer in condensed vapor and precipitating it with alcohol;[28] atomizing a solution of polystyrene plus plasticizer with steam;[29] and hot compounding to reduce methanol soluble material below 3 percent.[30] Properties of polystyrene compounded with 50–60 percent of powdered marble are described.[31] An article on the fabrication of polystyrene has appeared recently.[32] Organic amines were found to be light stabilizers for polystyrene.[33] Solutions of polystyrene in triaryl phosphates were disclosed as pressure sensitive adhesives.[34] Polymethyl styrene has been sulfonated to obtain a product suitable for sizing textiles.[35] The opacification of polystyrene was realized by heating it in boiling water.[36]

In order to produce high quality polystyrene, a vacuum apparatus and magnetic separator remove fine powder and dust from atmosphere during manufacture and packaging

PHOTO, COURTESY DOW CHEMICAL CO.

Applications

Polystyrene dippers to withstand the sulfuric acid used in testing milk,[37] and polystyrene plus dibutyl phthalate for microscope mountants,[38] illustrate two diversified uses for this material. A study of plastics in the refrigerating industry showed many advantages for polystyrene.[39] A new electron microscope replica technique[40] for the observation of minute surface details involves molding polystyrene against a metal or other solid surface, dissolving away the metal, and depositing a thin silica film on the polystyrene. This silica film is then removed and examined in the electron microscope. Polystyrene is preferred for this work because of its dimensional stability, its chemical inertness, the ease with which it is wetted by the silica, and especially because its excellent flow characteristics and moldability allow it to reproduce structural details down to the limits of resolution of the electron microscope, or roughly 40 A.

Mechanical properties

Creep and cold flow,[41] mar resistance[42] and chemical resistance[43] of polystyrene have been investigated. The effect of temperature on mechanical properties[44] and the influence of atmospheric conditioning on flow were also studied.[45] An inquiry was made concerning the change in mechanical properties of polystyrene as a result of grinding.[46] A value for the coefficient of expansion of polystyrene was reported.[47] Several investigations[48,49] concerned a correlation between orientation and mechanical properties of polystyrene. Plasticizers to increase the flexibility without impairing the electrical properties of polystyrene were listed as follows: Octahydrophenanthrene,[50] phenanthrene,[51] condensed diamyl naphthalene or polymerized methyl styrene,[52] and other hydrocarbons.[53]

Copolymers

Numerous styrene copolymerizing agents have been investigated: Propene and higher olefins;[54] butadiene;[55] nuclear alkylated styrenes;[56] phenyl acetylene;[57] methyl isopropenyl ketone;[58] methyl acrolein;[59] polycyclopentadiene;[60] tung and oiticica oils;[61] vinylidene chloride with vinyl acetate or methacrylates;[62] methyl α-chloroacrylate;[63] α-substituted allyl methacrylate or acrylate;[65] allyl crotonate or divinyl ether;[66] esters of crotonic acid;[67] hexyl crotonate in isopropyl benzene;[68] alkenyl or aralkenyl cinnamates;[69] unsaturated esters of phosphoric acid;[70] styrene or nitrostyrene with an acrylate or methacrylate,[71, 72] unsaturated ester or ether derivatives of dioxane;[73] esters of 2-chloroallyl alcohol such as bis (2-chlorallyl) oxalate;[74] an unsatured ester with at least two olefinic linkages, and about 50 percent of a compatible plasticizer.[75]

A copolymer of styrene and maleic anhydride is made water soluble by treatment with an alkali metal base.[76] Again, styrene-maleic anhydride copolymers are nitrated on the ring. The nitro group is reduced and then coupled with an azo dye-forming material to yield a colored polymer.[77] The interpolymerization and condensation of aralkyl chlorides with styrene in the presence of aluminum chloride is another variation in the quest for new polymers.[78] Similarly, chlorinated paraffins and styrene yield a low molecular weight polymer in the presence of aluminum chloride,[79] while unsaturated hydrocarbons from cracking are reacted with styrene, using boron trifluoride.[80]

Several modified polystyrene compositions have also been patented. For example, a mono-olefin polymer is dissolved in monomer styrene and the mixture (*Please turn to page 126*)

Money's Worth

THE STATE OF UTAH is issuing sales tax tokens of Tenite, thus conserving many tons of metal for warfare. The Tenite tokens are molded complete by rapid injection, requiring no subsequent stamping or polishing operations, and have withstood tests for the abrasive wear of constant handling.

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General

PLASTICS IN PERIODICALS 1935-1941. A BIBLIOGRAPHY. N. Bleyhl and R. Hagedorn. A mimeographed 27-page bulletin issued by the Sullivan Memorial Library of Temple University, Philadelphia, Pa., listing non-technical articles on plastics which have appeared in periodicals between 1935 and 1941, inclusive.

EIGHTEENTH ANNUAL SYNTHETIC FIBER SECTION. Textile World *92*, 99–114 (Sept. 1942). A group of articles on synthetic fibers and the role they are playing in our present fight. The first article on "How Much Fiber—and for What" by D. G. Woolf, gives data on the present production of fibers and a discussion on what may be needed. The article on "Fabrics for Military Purposes" discusses the use of rayon, nylon and other synthetic fibers by our military agencies. A list of specifications which require synthetic fibers is given. The article on "Fabrics for Civilian Use" covers blends which are available for the men and women behind the men behind the guns. There are several other articles on the processing of synthetics and blends. The last article, by K. B. Cook, deals with "Warmth and Wearing Qualities" of rayon and wool blends. Blended fabrics containing low percentages of wool have real value, especially when it is necessary to make a pound of wool go as far as possible.

SYNTHETIC RESINS AS INSULATION FOR ELECTRICAL CONDUCTORS. I AND II. E. Pallas. Kautschuk *17*, 82–4, 94–5 (1941). A survey of synthetic resins used in Germany for insulating electric conductors and for cable sheathing. Vinifoil gives excellent protection from water at moderate temperatures. Cellulose triacetate films have higher temperature stability but greater water sensitivity. Polystyrene films are suitable for condenser construction, high frequency cable, carrier-frequency telephony and long-distance transmission. Styroflex is superior to paper in loss at high frequencies, in water resistance and in damping. Cellulose triacetate rayon, because of its superior insulating properties, can be used to replace silk. Electric cable sheathing materials can be made from acrylic resins and Stabol 512, a vulcanizable substance. Synthetic resins can be used to replace rubber for insulating conductors. Cables laid in the earth or water require lead sheathing for good performance.

SOYBEAN PLASTICS. G. H. Brother. Chem. and Eng. News *20*, 1511–12 (Nov. 25, 1942). A short account of the development and properties of soybean plastics.

Materials

PETROLEUM RESINS. C. A. Thomas. Chem. and Eng. News *20*, 1507–8 (Nov. 25, 1942). A short description of the manufacture of hydrocarbon resins from unsaturated petroleum distillates. The catalysts used are anhydrous aluminum chloride, sulfuric acid, activated clays and boron trifluoride. Resins with a variety of properties may be produced. They are used mostly in lacquer formulation.

PRODUCTION OF SYNTHETIC RESINS AND PLASTIC MASSES FROM WASTES OF THE CRACKING OF GASOLINE. I. P. Losev, N. Parlashkevich and E. Godzevich. Inf.-Tekh. Byull. Glavkhimplast *1940*, No. 2, 50–6. An alkaline residue separated in the refining of the cracked distillate was heated with formaldehyde to obtain a resin. The material has the appearance of a resol or resistol, depending on the conditions of the synthesis. The unpleasant odor can be removed by treating the alkaline residue with steam.

FILLERS FOR PLASTICS. E. E. Halls. Plastics *6*, 267–74, 304–11, 352–8, 384–94 (Aug., Sept., Oct., Nov. 1942). The properties of the various fillers used in the plastics industry and their effect on the product are discussed. Data are given on the water absorption, specific gravity, heating loss, strength properties and stability of various fillers and plastic material containing various fillers.

Molding

INJECTION MOLDING OF THERMOSETTING RESINS. R. Hessen. Kunststoffe *31*, 245–7 (1942). Compression and injection molding methods are compared. Complete curing is of greatest importance when quality of the finished article is considered. Uneven curing in injection molding can be avoided by using small heat tubes instead of short large diameter nozzles. The tubes must be so designed that the gases formed are given off and the cavity filled while the resin is still plastic. Flow through the tubes and filling of the mold cavity must be rapid because the resin loses its plasticity quickly after it reaches the curing temperature.

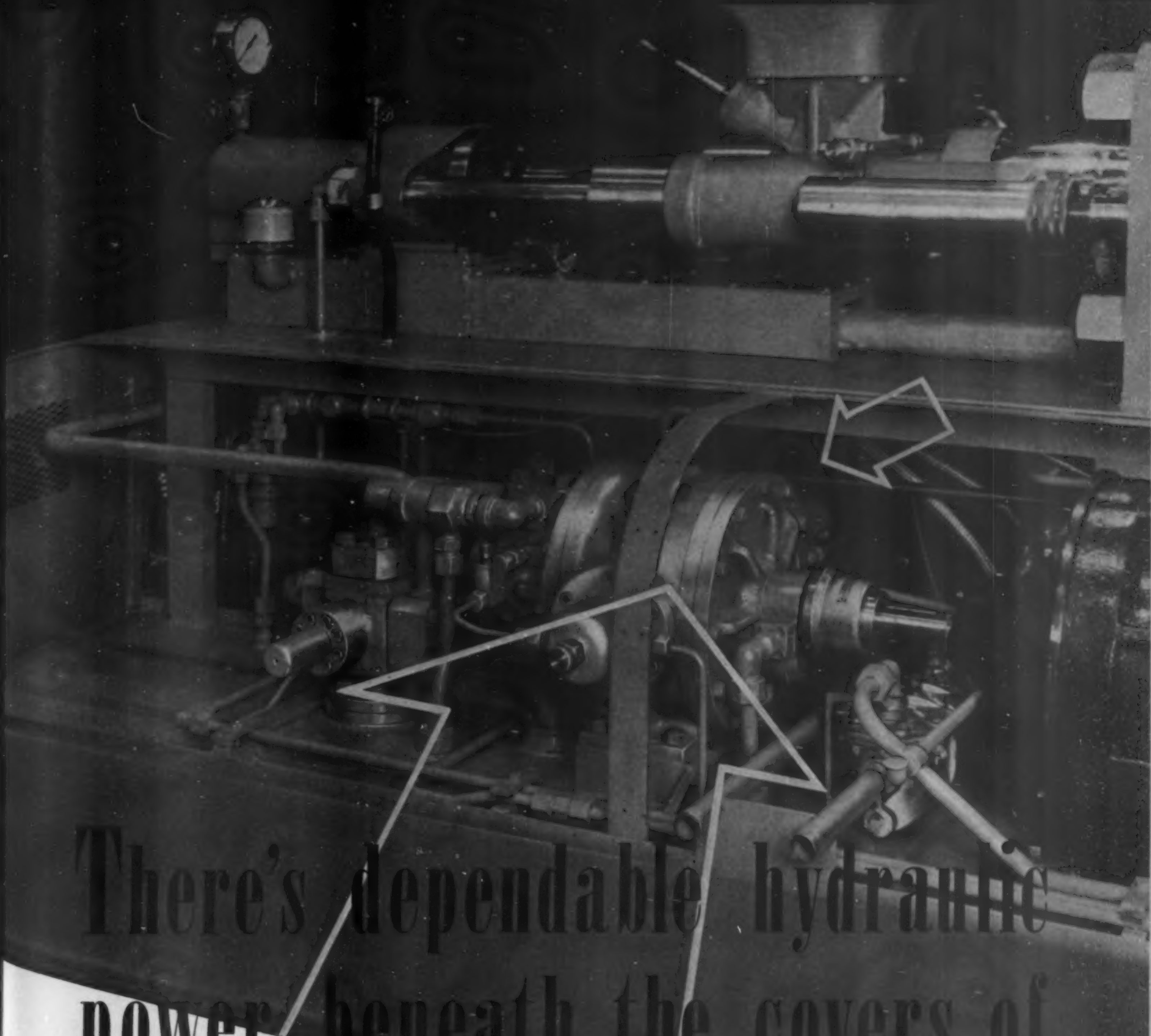
Applications

NEW RYAN PT-25 TRAINER BUILT OF NON-STRATEGIC MATERIALS. Aero Digest *41*, 198–202 (Oct. 1942). This plane, a trainer, is described as being the nearest approach to complete elimination of strategic materials yet achieved in military aircraft. The plane was designed to utilize plywood effectively. Constructional details and performance data are given.

LAMINATED PLASTIC. F. P. Hunsicker. Paper Trade J. *115*, 41–4 (Sept. 17, 1942). A description of paper or cloth laminated phenol-formaldehyde plastics used in the paper industry. The plastic is reported to have the following properties: tensile strength 9000 lb./in.^{2}; compressive strength 36,000 lb./in.^{2}; flexural strength 14,000 lb./in.^{2}; moisture absorption less than 1%; hardness 110 Rockwell M scale; specific gravity 1.35; resistance to abrasion, acids, alkalis and other chemicals encountered in paperboard mills high. This material has proved itself in the following applications; suction box covers, doctor blades, toe blocks, bearings of various kinds, shake springs and seal strips.

Coatings

COATING BY THE ELECTRIC SPRAY METHOD. H. Ransburg. Metal Finishing *40*, 621–3 (Nov. 1942). A new method for applying organic coatings to both conductive and non-conductive materials is described. An electric charge is imparted to sprayed particles in such a way as to cause the particles to be attracted to the article being coated. The proper electric power is obtained from a power pack which is designed to produce a high voltage, approximately 100 kv. D. C., and a very low current, less than 10 M. A. The electrodes which surround the grounded article are sharp points or fine wires, which must be properly spaced from the piece and from each other to obtain proper coating. Spray guns of standard make, air operated automatic type, are used. Any type of organic coating may be applied. The viscosity must be less than that used in ordinary spray coating; this is obtained by the use of more thinner or special thinners. This process reduces considerably the amount of coating lost and gives a more uniform film. A method is also described for removing the "fatty edges" from dip coated articles.



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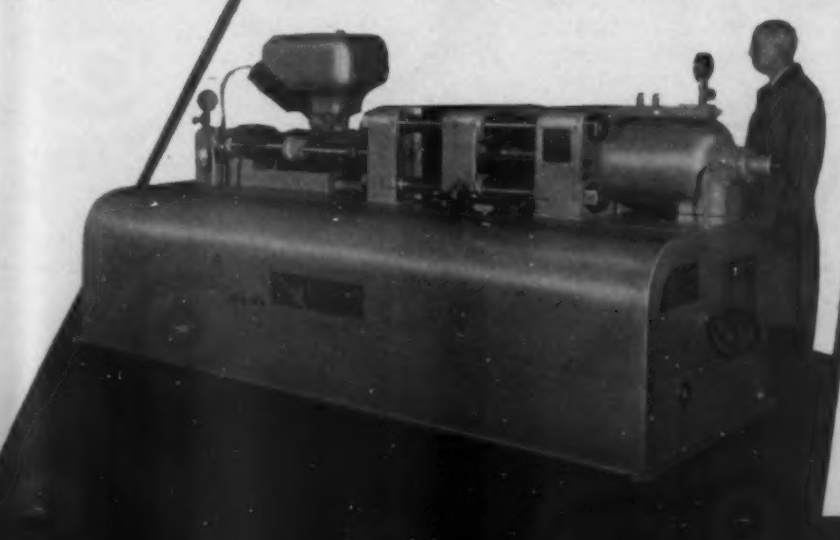

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Technical briefs

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Engineering

DESIGN INFORMATION ON "LUCITE." W. C. Wall. Aero Digest *41*, 122-9, 254 (Oct. 1942). A comprehensive article on the mechanical properties of methyl methacrylate resin. The manufacture of the monomer and the structure of the monomer and the polymer are discussed. The data given were obtained on samples of cast aircraft sheeting. The effects of temperature, fatigue, moisture, orientation, and the shape and surface condition of the finished article on tensile, flexural, compressive and impact strengths are shown. It is pointed out that in the design of members subjected to continued tensile and flexural loads the fiber stresses should not exceed 1000 p.s.i. for temperatures below 77° F. and 650 p.s.i. for temperatures between 77° F. and 100° F. Data are also given on the moduli of elasticity in tension, flexure and compression, on shear strength and on hardness. It is reported that tests are being made to determine creep, flow under pressure, abrasion resistance and impact properties.

THE USE OF UREA-FORMALDEHYDE RESIN FOR WATERPROOFING STARCH USED IN CORRUGATED AND SOLID FIBERBOARD PRODUCTION. P. B. Taft. Paper Trade J. *115*, 30-2 (Oct. 15, 1942). The use of water-soluble urea-formaldehyde resins for waterproofing starch and other carbohydrates used in the manufacture of paperboard is discussed. The factors which affect the waterproofing are (1) the concentration of the reactive constituents, (2) the temperature and (3) the hydrogen ion concentration. There is not sufficient evidence to prove that these resins react with carbohydrates.

SYNTHETIC RESIN EMULSIONS FOR PAPER SATURATION AND SIZING. R. T. Nazzaro. Paper Trade J. *115*, 29-32 (Nov. 5, 1942). A discussion of the use of resins for impregnating paper to replace rubber latex saturated papers. These materials are used in artificial leather products in shoe making. Synthetic resins may be used to extend latex or reclaim dispersions for the saturation of paper. Resin saturated sheets and flexible paperboards, completely free of rubber in any form, are in commercial manufacture. Vinyl polymers are suitable substitutes for rubber latex. Their water sensitiveness can be improved by the incorporation of an acrylate, or a thermosetting resin. Reclaims and straight alkyd resins are poorer saturants than the vinyls but are superior in water resistance. Aging qualities of resin sheets if properly plasticized and compounded are superior to those made from latex and reclaim. Reclaim sheets on the whole age better than latex sheets. Reclaim can be improved by additions of long-oil, high-molecular alkyds and high-polymer vinyl acetate. None of the resins investigated improve the binding properties of rubber latex. Selected resins can be utilized to extend supplies of synthetic rubbers.

Chemistry

CRYSTALLINITY IN CELLULOSE ESTERS. W. O. Baker. Scientific Monthly *55*, 435-7 (Nov. 1942). A study of the orientation of the molecules in thin films of cellulose ester. The study was made by photographing x-ray beams after they had passed through the films. This shows diffraction patterns which can be measured to show distances between the molecules as small as a billionth of an inch and also to indicate how the molecules are placed with respect to each other in the solid. When cellulose esters are quenched by cooling them rapidly from the molten state, the long polymer molecules are found to be disordered with respect to each other. When the plastics are cooled slowly from the melt, much greater order results, although perfect orientation is not found. When the molecules in the plastic have the maximum disorder, the material tends to be soft and flexible. When they are ordered, or crystallized, the material is hard and strong, and sometimes brittle. The most desirable state for toughness is somewhere between these two extremes. By proper quenching, various amounts of order and disorder may be produced. In the past, two methods of regulating the order of the molecules have been 1) by controlling the shape of the cellulose ester molecule, and 2) in the preparation of dope and lacquer films, by solvent formulation. Various solvents were found to cause different amounts of molecular order in the films.

PHENOL RESINS. S. S. Mindlin and D. V. Khodakova. Inf.-Tekh. Byull. Glavkhimplast *1940*, No. 1-2, 57-65. Resins made from carbolic acid instead of synthetic phenol were soluble in benzene and oil. If the resin made from peat oils and formaldehyde is modified with phthalic anhydride and glycerol, an alcohol soluble plastic is obtained. Suitable catalysts are hydrochloric acid, acetic acid and sodium bicarbonate. The addition of rosin leads to embrittlement. When peat phenols are condensed with formaldehyde in the presence of ammonia, alcohol insoluble thermoplastic resins are obtained. If equal parts of peat phenols and synthetic phenol are used a normal resin is obtained.

Testing

THE HARDNESS AND SCRATCH RESISTANCE OF PLASTICS—A NEW METHOD OF TEST WITH DISCUSSION. D. Starkie. J. Soc. Glass Techn. *26*, 130 (June 1942). A method for measuring the hardness and scratch resistance of transparent plastics is described. The surface is abraded by means of 60-mesh carborundum falling at the rate of 40 grams in 55 seconds from a special apparatus. The effect is determined from the amount of light scattered which is measured photoelectrically. The following results were obtained: polystyrene 12.1, Perspex 17.6, cellulose acetate 20.6, celluloid film base 21.8, unplasticized Perspex sheet 30.0, glass microscope slide 111.3, common sheet glass 115.5, polished plate glass 131.3, Pyrex glass 183.2.

Properties

ELECTRICAL PROPERTIES OF SOLIDS. XIII. POLYMETHYL ACRYLATE, POLYMETHYL METHACRYLATE, POLYMETHYL - α-CHLORACRYLATE AND POLYCHLORETHYL METHACRYLATE. D. J. Mead and R. M. Fuoss. J. Am. Chem. Soc. *64*, 2389-93 (Oct. 1942). The dielectric constants and loss factors of polymethyl acrylate, polymethyl methacrylate (alone and plasticized with 20 and 30 percent diphenylmethane), polymethyl-α-chloracrylate and polychlorethyl methacrylate at temperatures in the range $-70°$ to $100°$ C. and at frequencies from 60 to 8000 cycles are given. The preparation of chlorethyl methacrylate is described.

THE PLASTIC-ELASTIC BEHAVIOR OF EBONITE. J. R. Scott. Trans. Faraday Soc. *38*, 284 (Aug. 1942). With rising temperature secondary bonds become unstable at a lower temperature than primary bonds. The relaxation of the secondary bonds, which is due to the lower temperature stability, accounts for all time effects in the deformation of ebonite. This hypothesis explains the time-deformation curves for constant stress, the effect of alternate deformation and recovery, the temperature-deformation curves, the main facts relating to the residual strain after recovery, the influence of the degree of vulcanization, and the effects of the incorporation of plasticizers, of ebonite dust and fillers, as well as deformation properties of butadiene rubber ebonites.

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POLYMERIZER. C. M. Fields and R. T. Fields (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,301,204, Nov. 10. Apparatus for polymerizing a monomer to a thick, sirupy stage has an agitator freely suspended from a support which can be moved up and down.

STRETCHABLE FILM. H. D. Minich. U. S. 2,301,222, Nov. 10. Stretched rubber hydrochloride film which will not shrink at temperatures up to about 70° C. but will shrink if heated till the crystalline structure disappears.

SHELLAC DERIVATIVE. S. Caplan (to Harvel Research Corp.). U. S. 2,301,253, Nov. 10. Condensing shellac with ethyleneglycol or diethyleneglycol to form a product which can be worked on mixing rolls.

CELLULOSE MIXED ESTERS. R. W. Moncrieff and H. Bates (to Celanese Corp. of America). U. S. 2,301,312, Nov. 10. Partially hydrolyzing foils or the like made of cellulose acetate succinate, cellulose acetate phthalate or like mixed esters.

CHEWING GUM. J. M. Schantz (to Hercules Powder Co.). U. S. 2,301,331, Nov. 10. Hydrogenated rosin as a stable chewing gum base without any objectionable taste, odor or physiological action.

IMIDE INTERPOLYMERS. H. W. Arnold, M. M. Brubaker and G. L. Dorough (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,301,356, Nov. 10. Interpolymerizing an olefin (not higher than octene) with N-methyl to N-butyl imides of maleic or like acids.

VINYL RESIN SHEETING. E. K. Carver (to Eastman Kodak Co.). U. S. 2,301,368, Nov. 10. Casting vinyl resin films or sheets from solutions, dipping the fresh film on its support in a nonsolvent bath, exposing the film to hot air and stripping it from its support.

GOLF CLUB HEAD. R. S. Carvill. U. S. 2,301,369, Nov. 10. Covering the wood core of a golf club head with a thick molded plastic sheath.

PERMANENT SIZING. W. W. Trowell (to Hercules Powder Co.). U. S. 2,301,480–1, Nov. 10. Permanently sizing textiles with a blend of ethyl cellulose and a thermoplastic synthetic resin, or with an emulsion of such a blend.

MOLDING MACHINE. J. W. Appley. U. S. 2,301,501, Nov. 10. The core box of a molding machine is mounted and fitted for transverse horizontal vibrations.

SIZE FIXATION. L. H. Bock and A. L. Houk (to Rohm and Haas Co). U. S. 2,301,509, Nov. 10. Insolubilizing water-soluble sizes by treatment with a formaldehyde-aminotriazine resin.

FILM SPLICING. J. Eggert and H. F. Nissen (vested in the Alien Property Custodian). U. S. 2,301,664, Nov. 10. Coating two film ends on one side with solvent, overlapping the coated ends and joining them under heat and pressure.

HYDROCARBON POLYMERS. M. Pier and F. Christmann (vested in the Alien Property Custodian). U. S. 2,301,668, Nov. 10. Condensing an olefin with a diolefin or an acetylene and polymerizing the product.

PHOTOGRAPHIC NEGATIVE. E. Bassist (to Wm. C. Toland). U. S. 2,301,770, Nov. 10. Forming a negative on a base which has translucent and opaque portions, the latter containing a vinyl resin, gum arabic, a water-insoluble colloid, an opacifier and an exposed chromic salt.

PHENOLIC RESINS. W. R. Thompson (to Catalin Corp. of America). U. S. 2,301,799, Nov. 10. Making phenol-aldehyde resins translucent and improving their machinability by adding an alkyl (methyl to propyl) lactate or hydroxybutyrate.

VINYL RESINS. T. L. Gresham (to B. F. Goodrich Co.). U. S. 2,301,867, Nov. 10. Compounding polyvinyl chloride with a liquid ester of 4-cyclohexene-1,2-dicarboxylic acid.

CELLULOSE ACETATE. B. T. Lamborn (to Hercules Powder Co.). U. S. 2,301,904, Nov. 10. Increasing the bulk density of cellulose acetate or its mixed ester derivatives by treatment with methylene chloride, stopping short of a colloiding effect.

CHLORINATED POLYMERS. A. Blömer and E. Konrad (vested in the Alien Property Custodian). U. S. 2,301,926, Nov. 17. Rubber-like polymers of butadiene, or interpolymers of butadiene and a vinyl compound, are disaggregated to a specific viscosity and then chlorinated in a solvent which is inert to chlorine.

MOISTUREPROOF FOILS. D. D. Lanning (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,301,959, Nov. 17. Using a partially resinified dimethylol urea ether as an ingredient of moistureproofing coatings on wrapping material.

PRESERVING DOCUMENTS. Wm. J. Barrow. U. S. 2, 301,996, Nov. 17. Laying a homogeneous thermoplastic film of cellulose derivative over a document to be preserved, covering the film with a nonadherent protective sheet and progressively applying heat and pressure from one edge to the other.

MOLD. F. Husarek (vested in the Alien Property Custodian). U. S. 2,302,030, Nov. 17. A mold having a shaping cavity and a heating unit bore containing a heating unit.

PRINTING PLATE. Leo Kollek (vested in the Alien Property Custodian). U. S. 2,302,037, Nov. 17. Making printing plates of superpolyurethane.

DRAWING ROLLS. J. A. Kennedy, Jr. (one-third each to H. S. Richards and W. Winchenbach). U. S. 2,302,126, Nov. 17. Flexible resilient covers for drawing rolls are made of a vinyl acetal resin in which the aldehyde component is not higher than hexanal.

FILLER. E. G. Almy (to Atlas Powder Co.). U. S. 2,302,286, Nov. 17. Compounding a soluble boric acid-polyhydric alcohol resin in an aqueous vehicle with an inert filler ingredient.

STARCH PASTES. S. N. Glarum and J. J. Thomas (to Rohm and Haas Co.). U. S. 2,302,309–10, Nov. 17. Making stable modified starch pastes by adding a water-soluble urea-aldehyde condensation product to partially hydrolyzed starch and heating the mixture. *(Please turn to page 106)*

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Let us tackle that plastics problem for you, and behold, you have no problem! Production? Yes, well over a hundred presses in our compression room alone and the finest injection molding equipment you can get. The best plastic for your job? We can advise you with facts based on working with all of them. Precision, you say? Well, Sir, we make all our own dies and molds in our own toolshop, that's the last word in accuracy. A question of design? That, Mister, is our meat. Makes no difference whether it's something entirely new, a changeover from metal, an improvement for economy, we'll show you something. Instead of doing it the hard way, with hit-or-miss results, take a tip from many of America's most famous companies* and do the best thing first. The best thing? "Take It To Tech-Art"!

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POLYAMIDE FILMS. R. M. Leekley (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,302,332, Nov. 17. Coating a surface with a dispersion of a synthetic linear polyamide, heating until the dispersion medium dissolves the polyamide and evaporating the liquid.

TRIMMING. Leon Nast. U. S. 2,302,342, Nov. 17. Forming ornaments on fabrics by shaping the fabric into successive hollow projections and molding a plastic cover on the convex side of each projection.

POWDERED FILLER. V. Yngve (to Carbide and Carbon Chemicals Corp.). U. S. 2,302,361, Nov. 17. Compounds of zinc or of iron, desirable as fillers in vinyl resins but normally harmful thereto, are safely utilized by sheathing the filler particles in a dried alkaline coating.

POLYMER RESIN. A. Bellefontaine (vested in the Alien Property Custodian). U. S. 2,302,363, Nov. 17. Heating a diallyl or polyallyl, or dicrotyl or polycrotyl, derivative of a polyhydric phenol to effect resinification.

DIE. A. C. Ericson (to Doehler Die Casting Co.). U. S. 2,302,367, Nov. 17. A combined casting and trimming die has ejector and cover portions separable on a parting face at which the main cavity connects with overflow cavities.

MIXER. A. L. Stone (to Pneumastic Co., Inc.). U. S. 2,302,400, Nov. 17. A device for mixing plastic and viscous materials utilizes a tortuous passage through a resilient body mounted in a casing and projecting therefrom at the discharge outlet.

NAPHTHALENE RESIN. J. L. Tetley (to Sharples Chemicals Inc.). U. S. 2,302,403, Nov. 17. Making oil-soluble resins by condensing mono- or dialkylnaphthalenes with formaldehyde, the alkyl groups being propyl, butyl or amyl.

CHLOROPRENE. S. Kiesskalt, W. Schaich, H. Brunotte and K. Winnacker (vested in the Alien Property Custodian). U. S. 2,302,445, Nov. 17. Emulsion polymerization of chloroprene by rapid flow through a small bore tube at 30–60° C. and much slower flow through a similar tube at 15–25° C.

POLYSTYRENE. R. C. Palmer, C. H. Bibb and W. T. McDuffee, Jr. (to Newport Industries, Inc.). U. S. 2,302,464, Nov. 17. Interpolymerizing *p*-methyl-α-methylstyrene with another alpha-substituted styrene to form a hard colorless resin.

ARTIFICIAL LEATHER. C. M. Langkammerer (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,302,557, Nov. 17. Coating fabric with raw rubber, applying shellac, curing and surface-hardening the rubber and baking on a coating of polymethyl acrylate and dephenylolpropane-formaldehyde resin.

RESISTORS. G. E. Megow and H. G. Thomson (to Allen-Bradley Co.). U. S. 2,302,564, Nov. 17. Molded insulated resistors for radio circuits are formed within a sleeve of thermosetting resin.

ROSIN POLYMERS. A. L. Rummelsburg (to Hercules Powder Co.). U. S. 2,302,576–7, Nov. 17. Polymerizing rosin or its esters in solution with the aid of fluoboric acid or its derivatives.

PLASTIC. R. S. Shutt (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,302,583, Nov. 17. Plasticizing chlorinated rubber with a *bis*-aryloxyalkyl ether.

ROSIN POLYMERS. I. W. Humphrey (to Hercules Powder Co.). U. S. 2,302,632, Nov. 17. Polymerizing rosin by treatment with hydrofluoric acid at a temperature between 0 and 200° C.

PILL BOX. L. Baron (to Victor Metal Products Corp.). U. S. 2,302,641, Nov. 17. A dispensing container for pills has its top and bottom portions molded from a synthetic resin composition.

CHEWING GUM. W. H. Carmody (to Carmody Research Laboratories, Inc.). U. S. 2,302,664, Nov. 24. Selectively hydrogenated pinene resin as a chewing gum base.

COATED ABRASIVES. N. E. Oglesby and F. Strain (to Behr-Manning Corp.). U. S. 2,302,711, Nov. 24. Sandpaper having a synthetic resin adhesive for the abrasive particles is treated with a swelling agent for the backing sheet to improve its behavior under fluctuating conditions of atmospheric humidity.

PLASTICIZER. T. F. Carruthers and C. M. Blair (to Carbide and Carbon Chemicals Corp.). U. S. 2,302,743, Nov. 24. Plasticizing vinyl resins with a chlorinated alkyl or glycol ester of a dicarboxylic acid.

AMMELINE RESINS. J. M. Grim (to American Cyanamid Co.). U. S. 2,302,765, Nov. 24. Condensing ammeline and a phenol with formaldehyde in specified proportions.

MATTING TEXTILES. A. Landolt, G. Widmer and H. Benz; A. Landolt and H. Benz (to Society of Chemical Industry in Basle). U. S. 2,302,777–8; 2,302,779, Nov. 24. Delustering fabrics with pigment-like particles of urea-formaldehyde resin.

MATTING TEXTILES. A. Landolt and H. Benz (to Society of Chemical Industry in Basle). U. S. 2,302,779, Nov. 24. Depositing particles of urea-formaldehyde on textile fibers for a delustering effect.

PLANOGRAPHIC PRINTING PLATES. W. C. Toland and E. Bassist; W. C. Toland and B. B. Burbank (to W. C. Toland). U. S. 2,302,816–7, Nov. 24. Using polyvinyl alcohol in plates for planographic printing.

POLYAMIDES. G. T. Vaala (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,302,819, Nov. 24. Use of *N,N'*-polymethylene-*bis*(salicylamide), having no aryl groups on its amide *N*, as an ingredient in synthetic linear polyamides with intrinsic viscosity at least 0.4.

STAIN. E. H. Bucy (to Atlas Powder Co.). U. S. 2,302,837, Nov. 24. A staining preparation in an aqueous vehicle contains a water-soluble boric acid-polyhydric alcohol resin.

INJECTION MOLDING. N. Lester (to Lester Engineering Co.). U. S. 2,302,873, Nov. 24. An injection cylinder for pressure molding machines has an annular pressure plunger which reciprocates in the injection and return strokes.

SLIDE FASTENERS. N. J. Poux (to Talon, Inc.). U. S. 2,302,911–2, Nov. 24. A feeding device for strips of joined molded interlocking slide fastener units; and making slide fasteners from molded parts by forcing molding composition through apertures in a tape into mold cavities on the other side of the tape.

LENSES. C. V. Smith (to Univis Lens Co.). U. S. 2,302,917–8, Nov. 24. Apparatus for simultaneously producing several optical planes from a sheet of resin; and a method for producing solid resin blanks for making high precision lenses in totally enclosed molds.

OLEFIN GUM. W. J. Sparks and R. M. Thomas (to Jasco, Inc.). U. S. 2,303,069, Nov. 24. Compounding a gummy isoolefin polymer (molecular weight 25,000 to 150,000) with 5–10 percent of a crystalline polynuclear hydrocarbon.

ARTIFICIAL BAIT. J. R. Townsend and Lars G. de Lagerberg. U. S. 2,303,097, Nov. 24. Molding fish lures from a molding powder which also contains a luminescent powder.

SAFETY GLASS. G. B. Watkins and J. H. Boicey (to Libbey-Owens-Ford Glass Co.). U. S. 2,303,151, Nov. 24. Forming laminated glass with the thermoplastic interlayer projecting beyond the glass layers to serve as a flexible attaching flange.

It takes a lot of rolling to make a snowball

Sometimes in the thick of this war production all of us are inclined to forget the obvious. In this vastly accelerated accumulation of experience we lose sight of the values it is building up for the future of plastic molding.

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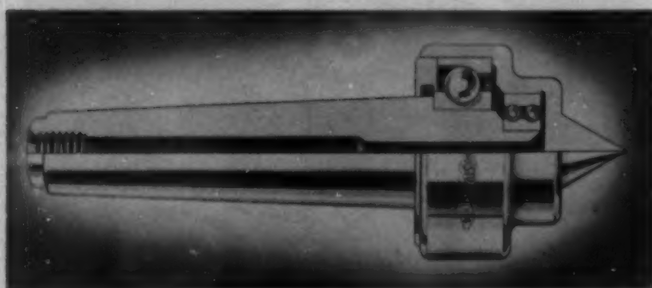


★ THE STURDIMATIC TOOL CO., DETROIT, MICH., announces the development of a new mechanical action live center (above). A live center when in use has two kinds of loads exerted upon the nose, radial loads and thrust loads. In this unit the radial bearing is mounted as close to the work as possible to reduce the over-hang. This construction is said to make it sturdy without interfering with tool clearance. The radial load is transferred from the bearing to the shank and the thrust load passes through the nose and the rotor housing to the rear or thrust bearing through the ball to the shank. A slight cushion action is obtained between points, which is said to protect the bearings from a thrust overload due to expansion of the work produced by heat and excessive overloads. The outer race of the radial bearing has an accurate slide fit, reported to prevent thrust loads on this bearing and also to prevent any deviation from the center. Lubrication is accomplished by removing a plug at the end of the shank and inserting an Alemite fitting. The lubricant is forced through the channel in the center of the shank into the rotor chamber.

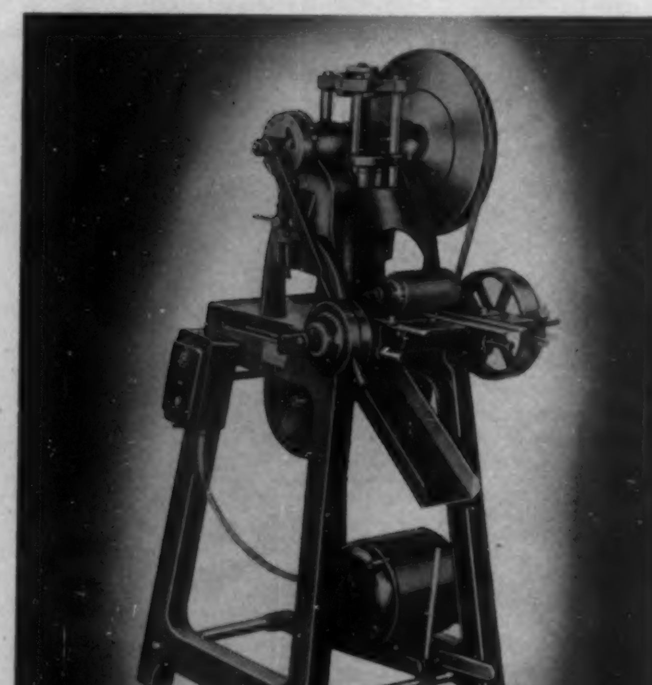
★ CHAS. F. ELMES ENG. WORKS, CHICAGO, ILL., HAS A new 6-plunger, fully enclosed, horizontal, hydraulic pump, with a maximum capacity of 400 horsepower. All moving parts are pressure lubricated and the connecting rods run in a continuous bath of oil. Roller bearings are used throughout. The compact, modern lines of the construction save space.

★ AMERICAN MACHINE AND METALS, INC., EAST Moline, Ill., announce a new hose tool which is described as making possible simplified and speedy hose connections for liquid, gas or air hose coupling. The device is available in two sizes: the Universal, or larger tool, made from brass and steel, is used to apply hose bands on 1-in., $1\frac{1}{2}$-in., 2- and 3-in. hose; the Junior unit, made of galvanized iron, is used to apply bands on $\frac{1}{4}$-in., $\frac{1}{2}$-in. and $\frac{3}{4}$-in. hose.

★ THE NEW ROTARY AUTOMATIC POLISHER FROM Hammond Machinery Builders, Inc., Kalamazoo, Mich., has been developed for handling a wide variety of circular parts such as aluminum pistons for aircraft engines, fuze bodies, engine valves, etc. As described by the manufacturer, the machinery consists of a circular aluminum table mounted over a heavy cast iron base. The table indexes automatically, rotating 6 to 8 chucks which pass under as many as four polishing wheels mounted on rigidly constructed pedestals. These chucks are stationary during loading or unloading operations. Polishing wheels are independently driven, either by V-belts from motor or direct on motor spindle. Controls for all motors are mounted on a master control board located at front of the machine.

★ MAINTAINING EXACT TEMPERATURE, PRESSURE, flow or liquid level according to a predetermined time schedule are the qualities ascribed to the new Taylor Fulscope Time Schedule Controller developed by the Taylor Instrument Co., Rochester, N. Y. After the processing time schedule has been determined, it is possible, according to the manufacturer of this piece of equipment, to repeat automatically and precisely the process as many times as necessary with this new unit.

★ THE INSTRUMENT SPECIALTIES CO., LITTLE Falls, N. J., reports development of Model M-25 Carson electronic micrometer, described as having been specifically designed for uniform thickness testing of all types of plastics and similar compressible materials. The instrument eliminates the human element in micrometer readings because highly sensitive electronic tubes replace the operator's judgment. The electronic circuit is said to give positive indication of setting point, independent of "feel" on dial. Thickness is read exactly as with a hand micrometer, and the instrument operates from any 110-volt, 60-cycle circuit. Exact thickness (to .0001 in.) of any portion of tested material can be determined.



★ FASTER PRODUCTION, ECONOMY OF OPERATION, automatic action, safety for operators, simplicity of design, facility for shutting off feed without stopping the press, access to dies for setting, three operating speeds, are the special features claimed for the new Diebel Hi-Speed Stamping Press (above) by the Diebel Die and Manufacturing Co. The press automatically produces small stampings of metal, fiber, plastics and other materials at adjustable speeds of 180, 370 and 500 strokes per minute. The feed mechanism is built in, and is described as capable of handling strip or coil stock with equal efficiency.

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Stokes Automatic Preform Presses, for precompressing molding powders into tablets or pills of uniform weight, density and form, are available in types and capacities to meet every requirement. We build stock model Single-Punch, Toggle-Type and Rotary Presses to apply pressures up to 80 tons, also presses from 100 to 300 tons capacity to meet special requirements.

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Rationed Rubber and What to Do about It

by Williams Haynes and Ernst A. Hauser

Alfred A. Knopf, Inc., 501 Madison Ave., New York, 1942

Price $1.75 **181 pages**

In the lexicon of the American war effort, few words have achieved the prominence and the significance of rubber. Out of the maze of conflicting information, ominous warnings, political recrimination and optimistic predictions, one fact emerges clearly—that there *is* a rubber "situation" which has ramifications that reach into every phase of American life.

Rationed Rubber tells an absorbing story which traces the development of this exciting and dramatic industry briefly and informatively from its violent beginnings to the here-now present. The facts about the rubber crisis are marshaled and set down, and several of the questions that have been agitating the American public as well as the Allied command have been intelligently resolved on the basis of these facts. How much wild rubber can we expect from South America? What good is reclaimed rubber? Synthetic rubber, etc.?

Mr. Haynes and Mr. Hauser conclude on a hopeful note. They concede that the "situation is grave but not desperate" and place the hope for the solution to the present rubber crisis in the synthetic rubber program and the conscientious and unremitting conservation of existing resources. L. C. A.

Advances in Colloid Science. Vol. I

Edited by E. O. Kraemer, F. E. Bartell and S.S. Kistler

Interscience Publishers, Inc., 215 Fourth Ave., New York, 1942

Price $5.00 **434 pages, 161 illustrations**

This volume is the first of a series intended to provide a medium for describing significant discoveries and advances in colloid science. It contains twelve papers relating to studies on surface phenomena, detergency, starch chemistry, thermodynamic properties of large molecules, constitution of inorganic gels, creaming of latex, synthetic-resin ion exchangers, sizes and shapes of colloidal particles and the electron microscope, contributed by investigators specializing in these respective fields. This commendable project is expected later to cover worldwide developments in colloid science. The physical make-up of the book is up to the usual standard of excellence maintained by the publishers in their several series of books on scientific subjects.

G. M. K.

The Men Who Make the Future

by Bruce Bliven

Duell, Sloan & Pearce, Inc., 270 Madison Ave., New York, 1942

Price $3.00 **325 pages**

The future of America and the hope of the entire civilized world rests not with the warriors, nor yet with political potentates, but with a relatively small, earnest and frequently anonymous group of scientists whose labors will ultimately result in the establishment of a new world order—quite different in its aspect from the efforts in that direction by our totalitarian contemporaries, according to the author.

Today it is the scientist who is helping to devise the weapons and methods that will bring this war to a speedy and victorious conclusion. But when peace has been restored, that will be the time for the rehabilitation of a war-torn world. Discoveries in medicine, in housing developments, transportation, fashion, in astronomy, biology, nutrition and industry, and in every field that is even remotely associated with human conduct and human progress, will have their effect on the shape of things to come. Not the least of these new developments are the plastic materials which will make their own contribution to the world of tomorrow.

L. C. A.

★ CELANESE CELLULOID CORP., 180 MADISON AVE., New York, has published a 63-page manual, *Cellulose Plastics in War and Industry*, written especially for industrial chemists and development men. Amply illustrated with full-page photographs, tables and charts, this book presents the most important forms of cellulose plastics, their properties and descriptions. It also contains valuable information that may suggest new approaches and new directions for those familiar with plastics.

For the person who is looking for complete information on the type of material desired, for assistance in a technical problem of molding or machining, for a combination of properties not found in other available raw materials, this manual will help solve his problem. Detailed technical information on sheets, rods, tubes, films and foils, molding materials, plasticizers, cements, dopes, glazing materials is given—a ready reference for all interested in the plastics industry. Wherever possible, recommendations on methods of use are noted under the type of material in question.

Written for the layman, the chemist, the physicist, the industry as a whole, this book is a tribute to the development and effectiveness of cellulose plastics in war and industry.

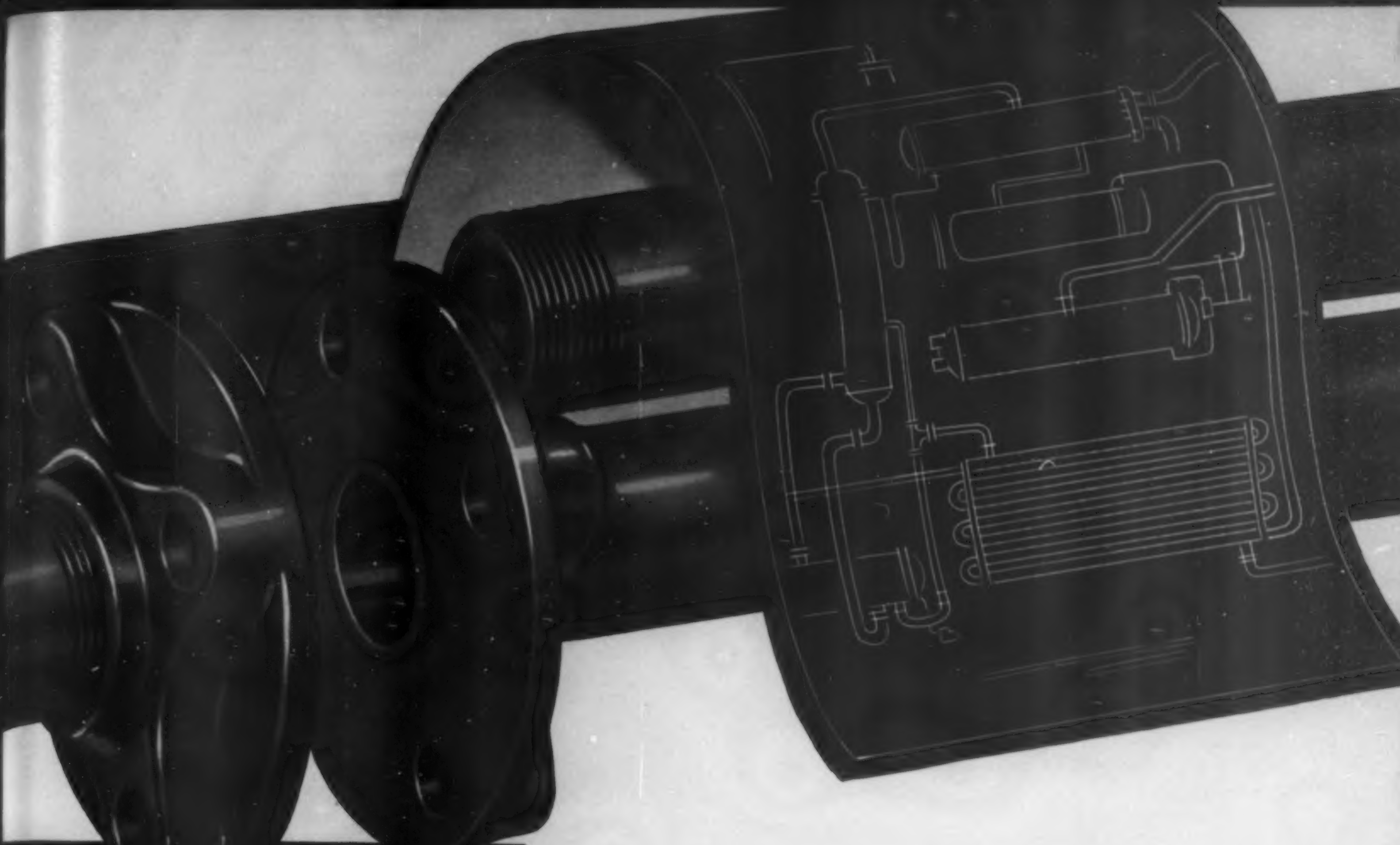
★ THE PUBLISHERS ANNOUNCE THAT A SECOND edition of the engineering handbook, "Technique of Plywood," by Charles B. Norris, has recently been brought out. In its addenda the new edition contains a chapter on "Strength and Deflection of Douglas Fir Plywood under Loads Applied at Right Angles to Face," and a chapter on "General Scientific Principles of Gluing," by I. F. Laucks, Handbook, with tables and charts, plastic bound, 250 pages, is published by I. F. Laucks, Inc., Seattle, Wash. Price is $2.50.

★ ISSUED BY PARKER-KALON CORP., 200 VARICK St., New York City, is a 20-page miniature catalogue covering all types of self-tapping screws in which the functions and advantages of each are described. Applications are illustrated.

★ A NEW 8-PAGE BOOKLET RELEASED BY FOREDOM Electric Co., 27 Park Place, New York City, illustrates and describes in detail the Foredom flexible shaft machines, grinders and accessories and their many possible uses.

★ "23 WAYS TO CONSERVE THE LIFE OF YOUR MULtiple V-Belt Drives," prepared by the Engineering Research Bureau of the Multiple V-Belt Drive Association, Chicago, is a contribution to the rubber conservation movement. Illustrated and written in layman's language, its purpose is to educate power users in the proper selection and care of multiple V-belt drives in order to obtain maximum life.

★ "MICARTA DATA BOOK," PUBLISHED BY WESTinghouse Electric & Mfg. Co., Pittsburgh, Penna., is intended to provide manufacturers with design and selection data which will simplify the application of the industrial plastic Micarta. The 35-page illustrated booklet is divided into sections on the manufacture of the product, laminated and molded Micarta, and machining data. Detailed grade selection tables and properties charts are given for both laminated and molded Micarta. Tables of standard shapes and sizes and tolerances of the laminated plastic, and application of directional loads, are included.



[illegible] 15 seconds for the entire process. Welded joints possess strength equal to that of the pipe itself. Saran pipe fittings are rapidly becoming available. Complete technical information is contained in free booklet "Saran Pipe."

SARAN PLASTIC PIPE

Replaces Strategic Materials Adds New Advantages

With American war production at an all time high, saran pipe is proving invaluable as a replacement for urgently needed metal and rubber. It is ready to go to work in widely diversified capacities—for chemical processing plants, rayon, paper, oil, gas and other industries.

But this Dow plastic development is far more than a "war replacement." It is new and revolutionary—*the first thoroughly practical thermoplastic pipe.*

Saran pipe is tough and durable. Exceptional chemical resistance gives it special value wherever corrosion and exposure conditions are severe. Moreover, saran pipe is only 1/4 the weight of comparable sizes of iron pipe, a factor of definite importance in shipping, general handling and suspension.

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PLASTICS

STYRON SARAN ETHOCEL

DOW

Washington Round-Up

Current news, Government orders and regulations affecting the plastics industry, with analyses of the plastics situation

MANNING TABLES

Newest wrinkle in setting up draft deferments for key workers is the Manning Table. Through its use, management can get a blueprint from which it can work out the manpower problem. Manning Tables will be distributed by the regional offices of the War Manpower Commission on request to employers whose plants are engaged in at least 75 percent war production, or who are performing some essential service such as are the public utilities, the railroads, etc. The Manning Tables are forms which, when filled out, provide an inventory of the personnel and job classifications in each plant. They determine how efficiently a plant is utilizing its working force, how adequate are its programs for training, upgrading and promoting employes, and provide a basis for planning improvements. They will provide each employer, in many cases for the first time, with complete information as to the number of employes who are subject to induction. A supplementary withdrawal and replacement schedule will offer him guidance in planning replacements so that his production will not suffer when his employes enter military service.

An employer filling out a Manning Table must expend some time and effort in gathering the required information, but will, in return, receive information which will enable him to plan adequately to meet his labor needs of the future. The Government will, in turn, receive information which will furnish the basis for the orderly withdrawal of workers who must, under Selective Service, be released to the armed services. The company retains one copy of the complete table and sends four to the WMC regional office. The regional office keeps one and sends a copy each to the State Director of Selective Service, the War Manpower Commission in Washington, D. C., and the local Director of the United States Employment Service

G. T. KELLOGG

Expanding its policy of furnishing on-the-spot news from the nation's capital, MODERN PLASTICS magazine announces that on January 1, 1943, G. T. Kellogg assumes the editorial chair of its Washington Bureau. For more than 12 years, Mr. Kellogg has covered the business news front in Washington and he is now going to devote his full time to representing MODERN PLASTICS in that busy city, reporting news, trends and current developments of interest to the plastics industry. Mr. Kellogg will analyze and interpret the significance of price and priority controls, manpower regulations, wage-freezing and all of the myriad actions taken in Washington. Our new office and new Washington Editor will be located in the National Press Building. Readers seeking Washington information involving plastics will always be welcome.

After drafting the Manning Table, the employer will draw up a replacement schedule to direct him in upgrading, promoting and recruiting replacements for workers which the compiled information shows him will soon be inducted. When the replacement schedule has been accepted by the State Director of Selective Service, the employer will be authorized to use a State acceptance number on Forms 42-A filed in accordance with the accepted replacement schedule. The employer will fill out an affidavit—Occupational Classification Form 42-A—for all employes within the ages liable to military service for whom occupational deferment is then necessary.

It will not be necessary at the present time for employers to file such affidavits for employes who have wives and children with whom they maintain a *bona fide* family relationship. The employer will, however, file a Form 42-B for such employes. These forms 42-A and 42-B are then forwarded to the local Selective Service Boards concerned. When the employe is classified or reclassified, the local board will notify the employer. Once the Manning Tables and replacement schedules are in operation, deferment of workers will be subject to periodical review.

Complete explanation of how to fill out the table can be obtained from the local office of War Manpower Commission located nearest to your plant.

PHENOL ALLOCATIONS

The first allocations under the new end use order for phenols (M-246) were made in December. Sharp cuts in nonessential civilian uses and a general tightening up of all phenol allocations indicate a "tough minded" policy on phenol has finally taken hold. The allocations in detail are listed below.

PHENOLIC RESINS

Specialties—Requests for material for the following uses were filled in full: bonding and impregnation, resin for use with rubber, synthetic rubber, pitch or asphalt in molded articles and thread sealing compounds. Requests for material for the following uses were granted in part: abrasive (80%), friction material (84%), lamp and tube basing (57%), paint and lacquer bristle setting (99%), impregnation of solenoids and other electrical windings (70%), casting impregnation (95%), binding of composition cork (71%).

Molding Compounds—The following uses were granted in full: food closures, printing plates. Granted in part: industrial power and light (84%), medical equipment and supplies, scientific instrument parts (69%), civilian electrical apparatus; closures other than food, wine and liquor (85%), industrial equipment (70%), agricultural equipment (61%), health and sanitation (29%), replacement for civilian (domestic) appliances (72%), textiles, rayon equipment and parts (68%), replacement parts for automotive use (89%). Denied were requests for material for amusement articles, ashtrays and for wine and liquor closures. Phenolic resin already had been removed from civilian buttons and none was granted for this purpose.

Laminates—Requests for material for safety helmets were granted in full. Requests for material for electrical insulating parts were granted up to 98%. Other uses filled in part were: mechanical and structural uses (57%), phenolic gears, gear blanks, sheet material for use in gears (55%), corrosion resistant parts (49%) and heat insulation (53%). Requests for material for decorative purposes had already been denied in the past.

PARAPHENYL PHENOL RESINS

The following civilian requests were filled in part: electrical equipment, switch boards, circuit breakers (40%), containers, paper liners for bottle caps (1%), and coated abrasives (10%).

(Please turn to page 114)

Night Patrol

A—Airbrake piston—drilled, turned and grooved on lathe, milled.

B—Insulator—bandsawed, turned, drilled, and counterbored.

U BOAT? No, she's an American this one, prowling for the Japs . . . off Zamboanga . . . in the Gulf of Papua . . . or on the Timor Sea.

The advantages of Synthane for submarine equipment are not naval secrets. Synthane is simply valued for the same properties that were so desirable in peace time applications, namely resistance to corrosion from solvents, acids, salts and water; structural strength, light weight, excellent electrical insulating properties and ease of machining.

Keep abreast of the developments in the field of technical plastics through Synthane folders. We'll gladly send them at your request.

SYNTHANE CORPORATION, OAKS, PENNA.

10% for War Bonds—Treasury Department Honor Roll

Plan your present and future with plastics

SYNTHANE TECHNICAL PLASTICS

SHEETS • RODS • TUBES • FABRICATED PARTS

SYNTHANE

Bakelite — laminated

SILENT STABILIZED GEAR MATERIAL

The following civilian requests were denied: road building equipment, refrigerators, inks, communications, laboratory equipment and experimental work.

RESIN COATED FABRICS

Because of military requirements, a critical shortage exists in raw materials normally used for the production of vinyl resin and pyroxylin-coated fabrics, and consequently their use in production for civilian use must be curtailed, members of the Pyroxylin Vinyl Resin Coated Paper and Fabrics Industry Advisory Committee have been told. Cellulose nitrate, film scrap, ethyl cellulose, castor oil and vinyl resins are critical raw materials, Wells Martin, Government presiding officer, informed the meeting. The already small supplies are decreasing as military requirements rise.

Emphasis was placed at the meeting on the urgent need for research by the industry to find new and less critical materials to use in place of the present ones. Because of transportation difficulties, members were urged to recognize the importance of eliminating cross-hauling in the industry as much as possible. Used containers owned by individual companies may still be used by these companies, Government representatives stated.

PIGMENTS

The Chemical and Organic Pigment Industry Advisory Committee has considered means of determining the final use of pigments with which the industry is concerned. Government representatives of the Protective Coatings Section pointed out the necessity of determining such end-use. Members expressed the opinion that the end-use situation for pigment colors was favorable at this time. In view of possible future scarcities, however, the members recommended that all customers in the industry be asked to develop information regarding end-uses. A sub-committee was appointed to obtain information on the essentiality of the various pigments.

NEW CHIEF FOR THERMOPLASTICS UNIT, WPB

A new chief of the Thermoplastics Unit of the Plastics and Synthetic Rubber Section of the Chemicals Division, WPB, has just been selected. James R. Turnbull succeeds Dr. Ralph H. Ball who is returning to the Celanese Corp. on January 1.

Mr. Turnbull, formerly in charge of sales promotion and sales development for Monsanto Chemical Company, Plastics Division, Springfield, Mass., from which firm he is on a leave of absence, has been with the Section since May 1, 1942. Up to the present time, he has been assisting Dr. Ball on vinyl polymers and polystyrene and the administration of the orders controlling thermoplastics.

RUSH ORDERS OF SCARCE MATERIALS

Manufacturers and others who must place rush orders for scarce materials by telegraph or telephone were provided with simple methods for applying the appropriate preference ratings by an amendment to Priorities Regulation No. 3 announced by the director general for operations of the War Production Board.

Procedures authorized for telegraphic orders call only for the following certification in the body of the telegram, "Ratings indicated are certified pursuant to Priorities Regulation No. 3." The requirements of Priorities Regulation No. 7 for manual signature or authorization will be satisfied in such cases if the copy of the telegraphic order retained by the sender is signed or authorized in the manner set forth in that regulation.

In the case of a telephoned purchase order requiring shipment within 7 days, the person placing the order, provided he is an official authorized to do so, may apply or extend a preference rating to which he is entitled by stating to his supplier that the rating is certified pursuant to the regulation. Written confirmation of the order bearing a certification of the preference rating applied orally must then be furnished the supplier within 7 days. No rating received by telephone may be extended by a supplier until he has received this document.

In case of failure to receive written certification within the 7-day period provided by the regulation, a supplier may not accept any other order from his customer or deliver any additional material to him until the written certification is received. Suppliers are required to report to the WPB Compliance Division, on or before the 15th of each month, any telephone orders to which ratings were applied, which the person placing the order did not confirm with the written certification when due.

Another change, effected by the amendment restricts the amount of maintenance, repair and operating material to which preference ratings may be applied by a firm covered by a P order (other than P-100), as well as by the terms of the regulation, to the limit specified in the P order.

WPB ORDERS AND ALLOCATIONS

Acrylics—Effective January 1, 1943, War Production Board placed all acrylic resins and acrylic monomer, including such well-known commercial products as Lucite, Plexiglas, Acryloid, Crystalite and others, under rigid allocation and end-use control. Exceptions are deliveries of resins exclusively for dental use, acceptance of delivery for aircraft glazing other than instrument lenses, certain deliveries of acrylic monomer within the confines of one company and certain small order exemptions (M-260).

• • •

Phthalic Alkyds—Phthalic alkyd resins were placed under allocation on December 7 by the WPB through General Preference Order M-139. Shortage of raw materials needed to make the resins was the principal reason for the action, but allocation was also necessary in order to balance materials going into these resins against other demands for the same materials. Ninety-five percent of all phthalic alkyd resins are used for protective coatings, and they are an essential ingredient in superior coatings for military and naval use.

• • •

Container Enamels—Conservation orders M-108, M-116 and M-158 governing the use of can enamels, closure enamels and drum exterior coatings were revoked by WPB on December 17 by order of the Director General for Operations. These orders restricted the use of the following materials which are all governed by allocation orders: Tung oil, oiticica oil, castor oil, phenolic resins, alkyd resins, vinyl resins, ethyl cellulose and nitrocellulose. The only other materials affected by the three revoked orders were: Perilla oil, never extensively used in coatings and practically unavailable; urea and melamine resins, not controlled by allocations because they are not yet sufficiently critical; and natural resins (fossil gums) which are subject to Conservation Order M-56.

• • •

Reagent Chemicals—Chemicals prepared and packed for reagent use in laboratories are exempted from provisions of Limitation Order L-144 under Amendment No. 2.

• • •

Acetone and Butyl Alcohol—Maximum prices for fermentation acetone, normal fermentation butyl alcohol and normal fermentation butyl acetate have been revised by OPA. New ceiling prices are: 14.25 cents per pound for normal fermentation butyl alcohol and 7 cents per pound for fermentation acetone delivered in tank cars in eastern territory. In addition, the maximum price for normal fermentation butyl alcohol is fixed at 14.75 cents per pound. Differential for shipments to western territory or for shipments in drums in carload, or l.c.l. lots were not altered.

• • •

Machine Tools—Orders for machine tools placed after December 25 must be accompanied by a photostatic copy of the preference rating certificate under which the buyer obtained his rating, or by a certified copy (E-1-b as amended Dec. 19, 1942).

• • •

Methyl Methacrylate Scrap—Supplementary Order M-154-b governing the use of methyl methacrylate scrap has been revoked by order of the Director General for Operations. Revocation is effective January 1, 1943.

TIME has never been so important in the affairs of men as it is today. Material arriving late on the field of action may as well never arrive at all. By maintaining its well deserved reputation for delivering "On Time," General Industries is doing its part in working for Victory, with facilities and experience unexcelled in the molded plastics industry. In war as in peace, General Industries molded plastics are noted for accuracy, quality and finish.

THE GENERAL INDUSTRIES CO.

Molded Plastics Division · Elyria, Ohio

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Milwaukee, Phone Daly 4057 · Philadelphia, Phone Camden 2215

In the plastics picture

★ THE FIRST ANNUAL MEETING OF THE SOCIETY of Plastic Engineers, Detroit Section, Chapter 1, was held in the Horace H. Rackham Educational Memorial, Detroit, Mich., on November 30.

During the daytime sessions new officers and directors were elected. The officers who will serve for the coming year are: William B. Hoey, President; Charles F. Hamilton, Vice-President; George Gress, Secretary & Treasurer. Fred Conley, William B. Hoey and George Gress were re-elected to serve as directors for a term of three years each. The business meeting was held in the evening, preceeded by an informal reception and dinner. Attendance was restricted to members and applicants.

Fred Conley, President of the Society, introduced the first guest speaker, L. T. Barnette, who addressed the members on the subject, "The Plastics Industry Should Prepare Needed Statistics." Mr. Barnette, of the Cellulose Products Department of Hercules Powder Company, and a former editor of MODERN PLASTICS magazine, outlined some of the problems involved in the plastics industry in relation to production of war materials. Following his talk, Mr. Conley suggested that the recommendations made by Mr. Barnette be studied by a committee.

The second guest speaker of the evening was Joseph Geschelin, Detroit Editor of the Chilton publications and co-author with Professor John Younger, of Ohio State University, of the textbook, "Work Routing, Scheduling, and Dispatching in Production." He is an automotive industry consultant, Bureau of Ships, U.S.N., and a vice-president, in charge of production activity, of the Society of Automotive Engineers. His subject, "The Automobile After the War," presented an interesting discussion on the relationship between the engineer of the automotive industry and the possibilities of new and lighter cars with rear engine mountings and increased mileage per gal. of gas consumption, and the engineers of societies such as the S.P.E. and others who would cooperate in the development of cars from an economic standpoint.

Annual elections of officers and directors of the National Governing Body of S.P.E. was held on December 12 in Detroit, Mich. The following were elected to serve for one year: President—Fred Conley, Chicago Molded Products Corp., Detroit Office; 1st Vice-President—John Bachner, Chicago Molded Products Corp., Chicago, Ill.; 2nd Vice-President—Wm. Phillips, General Motors Research, Detroit, Mich.; Secretary—Philip Robb, Hercules Powder Co., Detroit Office; Treasurer—George Gress, Monsanto Chemical Co., Detroit Office; Directors—Robert H. Morehouse, Cardinal Corp., Evansville, Indiana; Charles Henry, Chicago Die Mold, Chicago, Ill.; William B. Hoey, Plastics Processes Inc., Detroit, Mich.; Nickolas Rakas, Chrysler Corp., Highland Park, Mich.; John A. Mickey, Ford Motor Co., Dearborn, Mich.; and Charles R. Burgess, Products Engineering Service, Detroit, Michigan.

★ THE MEETING OF THE ASSOCIATION OF CONsulting Chemists and Chemical Engineers, Inc., held at the Electrical Testing Laboratories, Inc., New York City, was attended by a full membership with invited guests representing the U. S. Army and Navy, and the WPB. The meeting was a "conference on war service" by independent consulting chemists and chemical engineers and privately owned laboratories.

★ A "TINLESS CAN" OF FIBER FROM SURPLUS CROPS is the result of chemical research by the Macmillan Petroleum Corp. of Los Angeles for a plastic-lined container impervious to oil. Direct processing of such crops as corn and other grains, flaxseed, tallow, animal tissues, bone and clay, has materialized in a container which claims a 10 percent reduction in weight.

★ IN RECOGNITION OF THE FACT THAT PLASTICS have come of age, the Baltimore Museum of Art and the Plastics Industries Technical Institute opened an exhibition entitled "Plastics for War and Peace" on January 7, 1943. Mayor Howard W. Jackson of Baltimore presided at the opening and J. Earl Simonds, technical director of the Eastern Division of the Plastics Industries Technical Institute, lectured on plastics. The new sound and color film *The Plastics Age*, produced by MODERN PLASTICS magazine was featured at the opening.

This exhibit stressed two facts: that the war has proved the merits of plastics, not as substitutes, but as independent materials; and that peace will see the spread of plastics into every phase of our lives, because they are, or can be made, better than most natural materials. A program of movies and lectures by Mr. Simonds and Dr. Ralph K. Witt, associate professor of chemical engineering at Johns Hopkins University will be given every Thursday evening until the exhibit closes February 4th.

G. P. ANDERSON

★ GEORGE P. ANDERSON, FORMERLY VICE-PRESIdent and general manager of the Auburn Button Works, Inc., has been appointed by Hydraulic Press Mfg. Co. of Mount Gilead, Ohio, as director of their Plastics Machinery Division. Mr. Anderson, a former member of the Plastics Molders Committee, has a broad background in production management and as a consulting engineer in this country, Canada and abroad.

★ THE THIRTY-SEVENTH IMPRESSION OF THE Perkin Medal, awarded annually by the American Section of the Society of Chemical Industry for outstanding work in applied chemistry, was presented to Dr. Robert E. Wilson, President of Pan American Petroleum and Transport Co., at a meeting at the Hotel Commodore, New York, N. Y., on January 8, 1943, in recognition of his research studies on such varied subjects as flow of fluids, oiliness, corrosion, motor fuel volatility, clay and glue plasticity, and humidity, and in recognition of his industrial contributions in the use of tetraethyl lead, petroleum hydrocarbon cracking, and adoption of chemical engineering principles by the oil industry. This was a joint meeting with the American Chemical Society, American Institute of Chemical Engineers, the Electrochemical Society and the Societe de Chemie Industrielle. Dr. Foster D. Snell presided.

★ DR. ROY A. SHIVE, OF THE CALCO CHEMICAL DIV. of American Cyanamid Co., has been appointed to supervise production and development of chemicals for synthetic rubber with the Rubber Reserve Co. At Calco, Dr. Shive supervised research and development of organic dyes and intermediates for use in the organic pigment industry. He is a recipient of the "Modern Pioneer" award of N.A.M. in 1940.

(*Please turn to page 118*)

In chromium plating, like everything else, there are variations of quality and experience. The variations are not always visible to the naked eye. So the best way to buy this service is to go to a reliable source.

Be as careful in selecting your chromium plater as you are in choosing a tailor. Look for the HC which stands for "hard chromium". Insist on HC chromium plating on your molds, dies, extrusion worms and other metal parts. HC chrome plate imparts a smoother, harder surface which means longer mold wear and finer finish on molded parts.

INDUSTRIAL HARD CHROMIUM CO.

Hard Chromium Specialists

15 Rome Street Newark, New Jersey

★ THE BRITISH PLASTICS INDUSTRY IS ALARMED at the unprecedented amount of publicity being given to the so-called golden future lying ahead of the industry, according to "World's Press News" of London. Large-scale attempts to invest money in various companies is the result, the paper says, of misleading and exaggerated statements being given prominence in the national press. At a recent conference of chemical experts, the chairman, C. Chapman, expressed the view that, on the contrary, the plastics industry would not show a rapid or sudden expansion after the war but would develop gradually.

Sir Herbert Morgan, chairman of a number of plastics companies, has given a public warning against any premature investment, pointing out that, apart from anything else, any forcing up of the prices of shares of existing companies might well prove injurious to the industry as a whole. Similarly, Walter G. Waldron, chairman of Erinoid, Ltd., in his speech for the annual meeting, reveals that the company's shares have made an unprecedented rise, from $1 to $2 since the end of October 1941, and warns investors that, as long as Excess Profits Tax is in operation, profits and dividends will be heavily limited. On the other hand, there seems a good deal of justification for the increasing interest being taken in plastics. Wartime developments have shown the extraordinary versatility of the industry.

★ FINISHED PRODUCTS OF SYNTHETIC FIBERS AND plastics are on exhibition at the New Jersey State Museum, Trenton, N. J. (above). Originally scheduled for November 1st to December 27th, this exhibition of Contemporary Products created so much interest not only throughout the United States but in South America and Europe, that the closing date has been extended to January 14, 1943.

★ THE MEETINGS FOR THE COMING SEASON OF THE Society of Chemical Industry, Montreal Section, Rubber and Plastics Division, have been formulated as follows: Jan. 8, 1943, a symposium to acquaint rubber chemists with the plastics industry and plastics molders with rubber technology; February 12, "Modern Developments in Adhesives," Dr. W. Galley, National Research Laboratories, Ottawa; March 12, a trip to Granby, P. Q., arranged with the members of the division as guests of the Miner Rubber Co.; April 9, "Developments in the Functional Utilization of Plastic Materials," H. K. Nason, Assistant Director of Research, Monsanto Chemical Co., Springfield, Mass. All meetings will be held on the second Friday of each month.

★ THREE NEW ARMY AND NAVY "E" AWARDS IN the plastics industry have been announced by Robert P. Patterson, Under-Secretary of War, and James V. Forrestal, Under-Secretary of the Navy.

Two molders and one mold maker join the rank of industrial establishments who have received recognition for outstanding performance on war work. We congratulate Franklin Plastic & Die Casting Co., Franklin, Pa., Mack Molding Co., Wayne, N. J., and Guy P. Harvey & Son, Leominster, Mass. Each of the selected plants will be privileged to fly the Army-Navy Production Award Pennant and all of their civilian employees will be awarded Army-Navy "E" pins.

★ A "CLEARING HOUSE FOR CONSULTANTS" HAS been established to assist industry, large and small, which must produce more and better than ever and under steadily increasing difficulties, such as shortages of raw materials, the need for substitutes and for new products, be they for military or civilian use, and the necessity of reorganizing erecting of plants.

Therefore the Association of Consulting Chemists and Chemical Engineers, Inc., 50 East 41st St., New York, N. Y. (Tel. LExington 2-1130) has established as one of its functions this free service, referring those who ask for assistance to consultants specializing in any given field.

★ OTTO W. WINTER, VICE PRESIDENT IN CHARGE OF manufacturing, Republic Drill and Tool Co., Chicago, Ill., was recently elected president of the American Society of Tool Engineers at their annual convention in St. Louis. Ray H. Morris, vice president, Hardinge Bros., Inc., Elmira, N. Y., was promoted to the first vice presidency, and D. D. Burnside, superintendent of the American Stove Co., St. Louis, Mo., was named to the post of second vice president. Clyde L. Hause, sales engineer, Gorham Tool Co., Detroit, and Frank R. Crone, chief tool designer, Lincoln Motor Co., Detroit, Mich., were reelected secretary and treasurer, respectively. Adrian L. Potter of Springfield, Mass., was named executive secretary of the Board.

★ HOW INTENSIFIED EFFORTS OF WAR PRODUCTION workers can help win the war supplied the theme of the talk given by Major Frank L. Leonard, executive officer of the Cincinnati District of the 5th Service Command, at a recent meeting of the Foreman's Club of the Formica Insulation Co. George Strotman, president of the club said that all foremen in the organization are going the limit to increase production for the war. E. G. Williams, representing the Trundle Engineering Co., Cleveland, discussed job evaluation and its relationship to the war effort. D. J. O'Conor, Jr., electrical engineer for the Formica company and Harry Gruenwald, assistant factory manager, discussed wartime applications of measures to increase production.

★ TUPPER PLASTICS, FORMERLY LOCATED IN CLINTON, Mass., is now fully established in its modern new steel and concrete factory at Farnumsville, Mass.

★ ANOTHER SYNTHETIC RUBBER PLANT, LARGE scale Government financed, has begun production operations in Kentucky. The unit is an important part of the Government's synthetic rubber program and will shortly be in full production for general purpose articles for the armed forces. Ultimately butadiene made from alcohol will be utilized.

★ SAV-WAY TOOL AND MACHINING CO. ANNOUNCES a change in name and address. Now known as Sav-way Industries, its new general offices and main plant will be located at 4875 East Eight Mile, Detroit, Mich.

★ THREE TECHNICAL MEN HAVE BEEN ADDED TO those loaned the Government by the B. F. Goodrich Co. to aid in the nation's synthetic rubber program. W. R. Hucks has been assigned to the operating division of the Rubber Reserve Company; R. G. Boyd has been appointed to the allocation division of W.P.B.; and R. J. Hull will serve on the staff of the Rubber Administrator.

★ GLYCO PRODUCTS CO., INC., 230 KING ST., BROOKLYN, N. Y., has developed a liquid coating, Heavealac, for keeping the surfaces of rubber and synthetic rubber products free from tack. It can be brushed or sprayed on the finished article, or small objects may be tumbled in a bath of the coating, which gives a continuous film said by its manufacturers to be resistant to gas to a considerable extent.

★ WALTER DORWIN TEAGUE, INDUSTRIAL DEsigner, has announced the appointment of Leo H. Rich as a member of his staff for the development of a postwar planning program. The purpose of the program is to assist industry in preparing for the postwar readjustment period, to plan for the reconversion of wartime machinery to peacetime production, and to assist in designing peacetime products.

(Please turn to page 152)

THE DOOR OPENS . . .

on a post-war refrigerator

Your hand will interrupt a tiny light beam and presto, the refrigerator door will slide (not swing) open . . . Will these be features of tomorrow's refrigerator? We think so. And because the day is closer than ever when we all can go back to products of peace, it's important, now, to dream a little, and plan for them.

And plastics should be part of your plan—plastics that may permit molding refrigerator cabinets in one piece, sturdy, impervious to chemical attack, easy to clean, attractive to look at, and easy to sell. When you're planning plastics, remember this: Kurz-Kasch engineers, tool makers, and molders have quite literally grown up with the plastic industry. These men and their machines now serve Uncle Sam. They will be at your service—soon. *For the duration, of course, our entire output is confined to war products, and only high-rated orders can be accepted.*

KURZ-KASCH

Planners and Molders for the Age of Plastics

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Society of the Plastics Industry

News and Developments

CANADIAN MEETING

A meeting of the Canadian Section of the Society of the Plastics Industry will be held in Toronto, Canada, on January 19, 1943, at the Royal York Hotel.

While the meeting is sponsored by the Canadian Section, the mutual wartime plastics problems and applications should assure a wide attendance by the United States industry, to which invitations are being extended. Both countries have developed numerous important plastic uses over the past year and the interchange of ideas between their respective representatives should do much to further common war objectives in this field.

Speakers are to include a number of authorities on the various phases of military plastics uses and molding methods which should provide those in attendance with plenty of up-to-the-minute information on recent developments, while representatives of the military and administrative branches of the Government will also be present. A banquet will wind up the day's sessions.

John D. Benedito, sales manager of Canadian Resins & Chemicals, Ltd., an affiliate of Shawinigan Chemicals, Ltd., and Carbide & Carbon Chemicals Corp., will present a paper on vinyl chloride acetate copolymers. Because vinyl resins have wide war applications, there is now considerable interest in this subject. Before becoming sales manager of Canadian Resins & Chemicals, Ltd., Mr. Benedito was connected with the research laboratories of Gulf Oil Corp. and later with Carbide & Carbon Chemicals Corp. at the Mellon Institute of Research.

With low pressure molding coming in for increasing attention and application, especially in the aircraft field, the talk to be delivered by Lawrence J. Marhoefer should be especially timely and instructive. Mr. Marhoefer ranks among the outstanding authorities in the United States on this subject, and currently has a book under way on "Engineering in Molded Materials" which is now running serially in *Aviation*. He is the chief engineer of Vidal Research Corp. of Camden, New Jersey.

The activities of the Society of the Plastics Industry's Technical Committee will be discussed by its chairman, Frank Warner.

Bakelite Corp. will be represented by C. A. Norris of that organization, who will discuss thermosetting injection molding.

One of the plastics industry's newest products, Columbia resin (CR-38 and 39) developed by the Pittsburgh Plate Glass Co., will be discussed in considerable detail by Wm. R. Dial of the Columbia Chemical Division. While this material is still being produced on a limited basis and output is understood to be concentrated in military applications, its properties are such as to suggest numerous and widespread future uses.

American Cyanamid Co. will also have a speaker on hand to present a paper on melamine and its growing war applications.

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While the Toronto meeting of the Canadian Section is occupying first place on the SPI agenda at the present time, it might be well to bring out here that plans are going forward on the California meeting which is tentatively scheduled for February. Just as soon as details have been arranged, an announcement will appear in these columns giving date and pertinent details.

• • •

Recently representatives of the War Committee on Radio, the Military Services and the Technical Committees of the Society of the Plastics Industry met at the Society's offices to further the work on the classification of plastic materials and design criteria to meet the needs of the various service branches.

Drafting groups are to be established with representatives from the Army, Navy and the various organizations interested in the use and development of plastic military parts, members of which are to be appointed by the War Committee on Radios, sub-committee on Insulating Material Specifications.

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The initial meeting of a series to be held by plastic sales engineers and sales representatives from the New York area was held on December 7, last, at the Old Timers Grill, New York, and judging from the turnout and the general interest expressed by those in attendance, these monthly meetings will render a real service to all those interested in the sales angle of plastics. The chairman of the committee is Chris J. Groos of the Boonton Molding Company, while C. W. Marcellus arranged the dinner. At the December 7 meeting, Wm. T. Cruse outlined the services which SPI could contribute to the group, including arrangements for speakers with messages likely to prove of interest; while Mr. Groos explained the purposes and objectives of the organization.

He pointed out that meetings of this type would do much to further the interests of all concerned through improving the knowledge of molder's representatives on new developments and improved methods of handling materials. Such representatives also are provided an opportunity to get acquainted with their competitors and through open and private discussions to help one another on their mutual everyday problems.

The group then heard a very interesting and instructive discussion on the properties and probable future uses of Pittsburgh Plate Glass Company's newly developed CR-39 from Wm. Dial of the company, followed by a comprehensive picture of saran tubing and pipe, proper methods of production and its uses.

• • •

A meeting of the SPI Button Section was held at the Hotel Astor, New York, on November 20. One of the important tasks of this Section is the creation of sales statistics. Those desired are to be worked out by the material committees. SPI is to compile the figures submitted in such a manner that individual company members will have a clear picture at all times on the trends in the industry as a whole. Only the group totals are, of course, to be released. The value of continuous statistics of this type are generally recognized, but to date the plastic button manufacturers have been without any authentic source.

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At present the Society is in the final stages of publishing a manual on assembly gluing. The manual was prepared by the Resin Adhesive Division of the Technical Committee. Its purpose is to promote the proper shop use of cold-setting resin adhesives for aircraft, marine and similar construction involving structural loads, and help to prevent some mistakes in this type of gluing.

Another manual is in preparation on extruded tubing and shapes, containing information likely to be helpful to the Armed services and to essential civilian groups.

• • •

As this is written, SPI's Labor Survey No. 4 is coming off the press for distribution to those companies which participated in answering the questionnaires. As was to be expected, wages showed an increase all along the line since the survey taken last February. The interest in this wage report has constantly grown and the number of companies participating in the latest one was the highest ever. Such statistics fill a very important need of a company in formulating wage policies since they provide a complete picture of the range of wages paid on each type of job, both for the country as a whole and for particular sections. Policies as to vacations, lunch hours, bonuses, etc., are also indicated. Names of companies reporting are not, of course, divulged.

THE CALL TO *Plastics*

The new plastic bugle now being made for the Quartermaster Department of the United States Army symbolizes the call to plastics, for it is the most recent example of the difficult problems being successfully overcome in the conversion of vital metals. It is a forward step by our designers and engineers in the art of injection molded thermoplastics. If you are in need of assistance to further the war effort or if you are now making plans for the years of peace to follow, the benefit of our experience and services are available to you without obligation.

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London Letter

BRITISH THERMOPLASTICS—ACRYLIC RESINS

POLYMERIZED methyl methacrylate resin is now extensively and almost exclusively used in the British aeronautical industry for gun turrets, nose pieces, cockpit enclosures, landing light cowls or windows, blisters, domes, etc., where high mechanical properties and retention of original "built in" clarity under the most difficult operational conditions is most important.

Methyl methacrylate resin (normal type) affords a clear and undistorted field of vision. From sheets two or three dimensional sections are readily molded, drilled, tapped, routed, cut, sawed, bevelled, etc. The plasticized resin is available in the United Kingdom as a cast resin in the form of sheets, rods and tubes, and as a thermoplastic molding powder for injection or compression presses. There is an Air Ministry specification, D.T.D. 339 (a) for methyl methacrylate resin to be employed for aircraft purposes which sets limits on loss of light by absorption and reflection, tensile strength, rate of burning, impact strength, change in dimensions and transparency after soaking in water, heating and exposure to arc light. The specified limits are: tensile strength greater than 2.75 tons per sq. in.; less than 4.25 tons per sq. inch. Light transmission not less than 90 percent after all treatments. Change of dimensions not greater than 0.5 percent after all treatments. The burning rate and the specified height of fall for the ball vary with thickness of sheet, but for 5/32-in. sheet the figures are: Time to burn down 6 in. wide, not less than 13 minutes. Material must not fail when 130-gram ball is dropped 2 ft. 11 inches. Material supported on steel supports at three points distant 3 1/2 in. from each other.

Considerable improvements have been made in the development of the British methyl methacrylate resin, Perspex, and production figures have been multiplied several times since the outbreak of war. The resin itself has also been improved, particularly the mechanical properties. Table at right gives the general and mechanical properties of present-day Perspex (plasticized).

Of recent interest is the attention now being given to unplasticized Perspex, which shows important differences from normal Perspex in several important properties. The distortion temperature (temperature at which rapid collapsing of specimen 1/4 in. diameter, 1/8 in. thick, under 1 kg. load commences) of normal Perspex is 78° C. as against 105° C. for the unplasticized Perspex. There are very considerable improvements in tensile, shear and impact strengths in the case of the unplasticized resin and also in the hardness, refractive index and relative dispersion.

There are a number of practical manufacturing difficulties in the large-scale production of unplasticized Perspex, but small quantities are available for special applications, particularly for small moldings requiring the highest resistance to heat.

Shaping of Perspex sheets for aeronautical work is nowadays planned on the simplest possible lines. Usual procedure on the part of British manufacturers is to dry-heat the sheet 100–125° C., depending on the thickness of sheet employed and type of shape or curvature. The sheets are usually heated for about 10 min. after the oven has reached the predetermined temperature. Formers are generally made of wood, preferably mahogany or bent plywood supported by a stout framework. For double curvatures—a common practice—the molds, made of well-seasoned timber are covered by fabric with a short pile such as billiard table baize, and then overlaid with a stretched rubber latex. Metal molds are only occasionally employed, and then only when cheap wooden formers are not able to produce a surface of the requisite smoothness or finish. In single curvature shaping, British molders find it sufficient to place the softened sheet of Perspex on the mold and allow it to cool in position. Double curvature shaping presents some difficulties, however, and the sheet is placed on the mold and the edge clamping device positioned as quickly as possible. The sheet is then stretched over the mold by pulling on the edges, and the clamping tightened until there is sufficient pressure to prevent the sheet leaving the contour of the mold once it has been stretched into position.

The usual mechanical operations of blanking and shearing, drilling, boring and tapping, etc., are not particularly worthy of special note. Some mention should, however, be made of cementing and riveting Perspex sheet. The cement recommended by the manufacturers (Imperial Chemical Industries) is a solution of methyl methacrylate polymer (Diakon) in a solvent mixture such as chloroform, petroleum, ether, etc. Cemented joints can be reinforced by riveting, using duralumin or aluminium rivets; and this type of joint has been successfully employed for jointing Perspex for the tail turrets of heavy bombers, such as Stirlings and Manchesters. In these cases the Perspex is shaped to double curvature and a fitted strap is riveted on the inside, using tubular aluminium rivets. The joint is made perfectly weatherproof by cementing along a 1/16-in. gap between the shaped panels on the outside. Tensile tests have shown that cemented joints do not shear along the cemented surfaces but that a fracture usually takes place at a point just clear of the strap at about 3 tons per sq. in., which is slightly less than the normal ultimate tensile strength of the material. (*Mailed Aug. 31, 1942, by Mrs. John S. Trevor.*)

PROPERTIES OF PERSPEX

General		
Specific gravity at 20° C.	1.19	
Effect of exposure to ultraviolet light	No visible effect in 480 hr.	
Loss in weight on heating	0.3–0.4% after 24 hr. at 80° C.	
Linear shrinkage on heating	1.2–1.8% after 1 hr. at 105° C.	
Water absorption in 7 days at 20° C.	0.3–0.4% by weight on specimen 2 in. × 2 in. × 3/16 in.	
Swelling after immersion in water for 7 days at 20° C.	0.03–0.09% increase in length on specimen 8 in. × 1 in. × 3/16 in.	
Mechanical		
Tensile strength at −60° C.	6.25 tons/sq. in.	Average values
Tensile strength at −40° C.	6.0 tons/sq. in.	Average values
Tensile strength at −20° C.	5.6 tons/sq. in.	Average values
Tensile strength at 0° C.	4.75 tons/sq. in.	Average values
Tensile strength at 20° C.	3.5 tons/sq. in.	Average values
Tensile strength at 40° C.	2.3 tons/sq. in.	Average values
Impact strength at 20° C.	3.2–4.2 kg. cm. (on specimen in accordance B.S.S. 488)	
Impact strength at −40° C. (Izod cut notch)	4.3 kg. cm.	
Ultimate fiber stress in bend at 20° C.	6.0–7.0 tons/sq. in.	
Shear strength at 20° C.	4.0–4.2 tons/sq. in.	
Proportional limit in compression at 60° C.	1.8 tons/sq. in.	
Proportional limit in compression at 40° C.	2.1 tons/sq. in.	
Proportional limit in compression at 20° C.	4.8 tons/sq. in.	
Proportional limit in compression at −0° C.	5.5 tons/sq. in.	
Proportional limit in compression at −18° C.	7.2 tons/sq. in.	
Proportional limit in compression at −40° C.	11.0 tons/sq. in.	
Compressive strength at −40° C.	14.5 tons/sq. in.	
Brinell hardness	18–20	
Modulus of elasticity at 20° C.	200 tons/sq. in.	

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FRANKFORD STATION P. O. PHILADELPHIA, PA.

Synthetic Rubber Compounds

Phenol-Furfural Products *Phenol-Formaldehyde Products*

The Editor's Mail Box

Dear Sir:

I have been connected with most of the plastic contracts which were awarded this year by the New York Chemical Warfare Procurement District, and because of my active participation on these contracts as an inspector for the Chemical Warfare Service, I was very much interested in the article, "Unusual Costs in War Work" which appeared in the November 1942 issue of MODERN PLASTICS. The article stated that, in many cases, costs on government contracts were greatly increased because of "rigid specifications and tough inspection." These two factors have very often been accused of being hindrances to the war effort, and on their behalf, a defense should be allowed for them.

Government contracts are awarded with the requirement that the material to be procured must conform to certain drawings and specifications. In most instances, the contract is accepted with complete knowledge as to what drawings and specifications are involved therein. However, few contractors take the specifications seriously when they make their bids. They feel that the only reason the specification was written is because someone in Washington wanted to keep himself busy, so he applied his literary talent to the writing of a specification on a subject with which, in their opinion, he was not thoroughly familiar. As a result of the complete disregard of the specifications, these contractors prepare themselves for production on the basis of their own opinions as to what standards are required.

For all government contracts representatives are available to aid the contractors in problems connected with design, manufacturing and production. If all the companies would avail themselves of this service before they begin "tooling up," many controversial questions could be discussed before any money is spent. However, several companies are too proud to accept outside help. Some of them won't disclose plans of their mold designs until they are sure that it is too late for their competitors to use them. Others are antagonistic toward the idea of allowing government officials to inspect their plant. Because of these conditions, government representatives are not given full cooperation at a time when an explanation of the specification requirements and quality standards could eliminate any necessity for making changes after tool work is completed.

During the course of a contract run, unforeseen difficulties inevitably arise. Some contractors become panicky when this happens. They insist that quality standards should be lowered rather than to stop production to make minor repairs. They contact Col. X or Capt. Y and make desperate attempts to obtain waivers which would allow them to deviate from specification requirements. They accuse the government inspector of delaying the flow of critical material because of his insistence that the specifications be adhered to. This attitude is in most instances not justified. The government inspector knows what the government wants, and he knows how badly they want it. He certainly won't take action which would delay production unless his office gives him instructions to do so.

In conclusion, here is some information which may prove to be valuable: *In nearly every case where several companies are making the identical item, the company which makes the greatest effort to follow the specifications produces the highest percentage of "acceptable" items, and has no reason to complain about "rigid specifications and tough inspection."*

Editor, MODERN PLASTICS
122 East 42nd St., New York
November 28, 1942

Very truly yours,
Raymond Mirrer
Inspector, C.W.S.

Dear Mr Mirrer:

I think every one of your points is very well taken—especially the last paragraph of your very interesting letter.

On this we are in complete accord. You may be pleased to know that the inspectors in the Chemical Warfare Service have an enviable reputation among those in the plastics industry.

On the bottom of page 69 in our November issue, you will note that we quote one molder as saying: "We are greatly impressed with the high type of individuals that we come in contact with on the technical procurement and planning end of Chemical Warfare Service. We find that these fellows 'know their onions' and that they readily appreciate any suggestions that we might offer which would tend to more efficient molding practice. . . . "

I think this is an acknowledgment of the high respect with which the industry regards the gentlemen who are inspectors for Chemical Warfare Service. Your own thoroughness is only another indication of why that regard is proper.

I don't mean to insinuate even for a moment that inspection was improperly done or that specifications should not be lived up to. I must admit that in some other branches of the service there have been inspectors and inspections which were unnecessarily "tough." I know personally of one instance where for some inexplicable reason an inspector refused to pass a job which rigidly adhered to specifications and held up some $35,000 worth of parts.

I must admit that this is a very rare exception—incidentally, this inspector is no longer in the service of the U. S. Government.

Sincerely,

December 9, 1942

Raymond R. Dickey, Editor

Road map for navigators

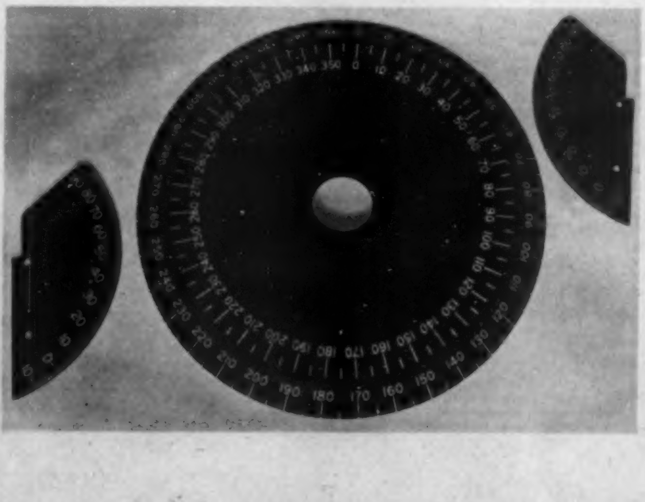
(***Continued from page 52***) speed and low cost.

To brand the laminate, it is first preheated by ultraviolet rays. Following the heat treatment, it is placed in a heavy duty press to which electrical heating elements are connected and the dies are heated to fairly high temperatures (200° F.). Heat and pressure are applied for from 7 to 10 minutes in the transfer or branding process, so that the impression and osserfoil dye used become permanently imbedded in the dial. Throughout the entire process, close supervision must be maintained and caution exercised to control highlights and to make sure that the impression transferred to the dial is consistent in its absolute evenness of lettering and calibration.

An indication of the degree of success on the job is the manufacturer's report that the margin of error on the entire dial is held to less than two seconds. The high degree of uniformity and consistency of impression was particularly difficult to obtain because of the size of the surface to be worked.

Credits—Material: Insurok. Fabricated by Ivorycraft Co., Inc., for Bettcher Manufacturing Co.

3—***Component parts of the azimuth dial—right and left protractors and the dial itself—ready for assembly. The dull, smooth finish of the material makes polishing unnecessary***



Machines, Accessories and Attachments for a Wide Variety of Needs:

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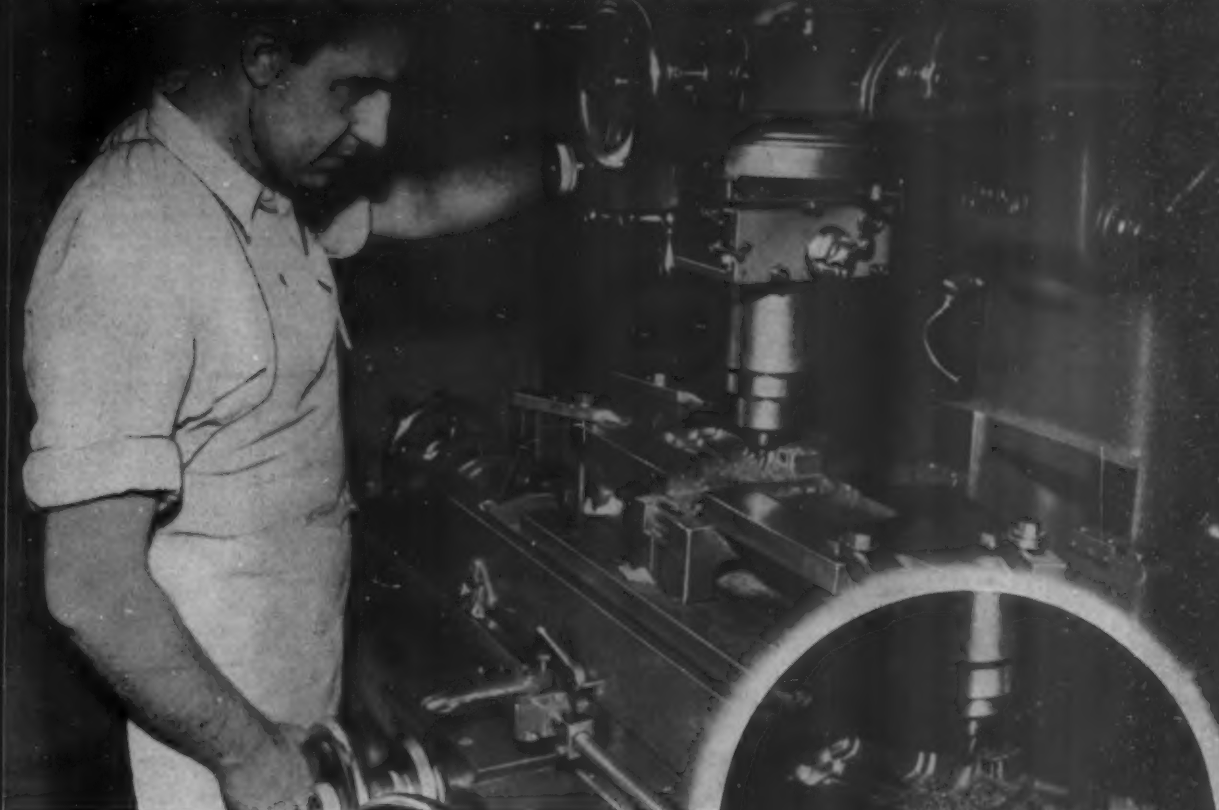

NO MODELS OR TEMPLETS NEEDED TO PRODUCE THIS PRECISION MOLD - - - -

The job illustrated above typifies the unusual performance of the Milwaukee Rotary Head Milling Machine. The permanent mold (cast iron) for aluminum shown above was produced in 60% less time than it previously required — without models or templets and directly from the blueprint into the metal.

The Milwaukee Rotary Head Milling Machine is without equal in the high speed, accurate, economical production of dies, molds, hobs, as well as the precision machining of many parts. In a single setup, it performs layout, milling, drilling, precision boring and slotting operations—mills circular and angular cuts in both vertical and horizontal planes.

* * *

Send for Bulletin 1002 A, giving full information on the Milwaukee Rotary Head Milling Machine and its remarkable, low-cost performance.

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Advances in plastics—1942

(*Continued from page 98*) is polymerized.[81] Likewise, monomer containing swollen rubber is polymerized, and the resultant polymer mixed with rubber, polyisobutylene or polythene.[82] Again, oils or waxes are mixed with monomeric styrene and polymerized.[83]

New materials

Some interesting modifications of polystyrene have appeared during 1942. Styramic, consisting of polystyrene and chlorinated diphenyls, is stated to possess improved heat resistance, complete nonflammability and excellent electrical characteristics.[84] Styraloy 22 is an elastomer flexible to −70° F., resistant to corona discharge at elevated temperatures and only slightly inferior to polystyrene electrically.[85] A new resin designated T-132 has been offered in experimental quantities. It exhibits properties intermediate between those of polystyrene and polyisobutylene.[86] An unsaturated monomer, α-methyl-*p*-methyl styrene, said to copolymerize readily with styrene, is now available in commercial quantities.[88, 89]

Electrical applications

The electrical applications of polystyrene are numerous, as usual, although some of the most interesting ones are connected with the war effort and cannot be revealed. Several patents dealing with styrene in electric condensers have appeared. Up to 25 percent of powdered lead chloride added to polystyrene will raise the dielectric constant without seriously increasing the power factor.[90] Hydrogenated polymerized styrene plus a plasticizer is also recommended for condensers,[91] as is a mixture of polystyrene and polyisobutylene, with or without polymerized divinyl benzene.[92] Flexible laminated films suitable for insulation are made from alternate layers of polystyrene and ethyl cellulose.[93] A coaxial cable prepared from polystyrene filaments wrapped around a wire has been patented.[94] Numerous patents on the use of styrene in electric power cables have appeared.[95] The uses of polystyrene in the electrical industry have been reviewed.[96, 97] An accurate measurement of the volume resistivity of polystyrene shows values of 10^{20} to 10^{21} ohm-cm.[98]

Basic research on styrene

Many interesting theoretical studies connected with styrene have appeared during 1942. Data have been presented on the heat of polymerization of styrene;[99] kinetics of styrene polymerization in various solvents;[100] vapor pressure,[101] osmotic pressure[102] and viscosity of polystyrene solutions;[103] molecular weight distribution curves;[104] and second order transition in polystyrene.[105, 106]

A critical evaluation of Staudinger's constant for polystyrene was presented;[107] while the dependence of viscosity on concentration of polystyrene in solution was studied.[108] The mechanical properties of concentrated polystyrene solutions was the basis of another report.[109] A turbidimetric method of estimating the amount of polystyrene in a solution was evolved.[110] Examination of polystyrene with an infrared spectrograph of high resolving power failed to detect the presence of methyl groups in appreciable quantities.[111] Properties of styrene-butadiene copolymers and of ring substituted bromo, amino, methoxy and alkyl polystyrenes were reviewed,[112] as were those of styrene-methacrylate copolymers.[113]

Polymerization of styrene in chlorobenzene,[114] in thymol[115] and in ethanol[116] solutions were reported. The action of chloranil[117] and benzoquinone[118] as polymerization inhibitors was studied. Another work showed that benzoquinone and styrene monomer react to form diphenylnaphthoquinones.[119] The effect of free radicals on styrene polymerization was investigated by several groups. Acyl peroxides,[120] *p*-bromobenzenediazonium hydroxide[121] and tetraphenyl succinodinitrile[122] were among the compounds tested. It was shown that styrene monomer can be detected with the polarograph.[123]

These numerous references indicate the widespread interest in styrene, and suggest the important rôle which this material is playing in modern science and technology.

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(*Please turn to page 128*)

The late **Mr. Vernon Royle** was the inventor of the tubing machine (1880) and creator of many subsequent developments in the art of extrusion. He was the guiding genius of our company, the man who set our basic principles of operation.

One of his precepts was always to keep in advance of the development of new plastics, by designing new machines. Another was to build each piece of equipment soundly, thoroughly, of the best materials. Both of these guides have been carefully followed—which is, perhaps, the underlying reason for Royle's consistent leadership of the extruding machine field.

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Vinylidene chloride polymers

by ROBERT D. LOWRY*

DURING the war period of 1942, vinylidene chloride polymers have helped to solve problems of national defense, both by filling needs in direct war applications and by furnishing replacements for critical materials such as rubber, nickel, aluminum, copper and stainless steel in essential industries. The technological development has kept step as evidenced by the literature[1-5] and U. S. patents.[6] These developments are necessary if these materials are to serve in as many applications as possible to aid in the speedy winning of the war. In addition, all of these advancements will later be available to broaden and enhance our living conditions when peace returns.

Extrusion has been developed considerably, using modified conventional extrusion equipment and methods. Tubing is being used in sizes from $^1/_8$ in. to $^3/_4$ in. for direct and indirect defense work as replacements for aluminum, copper and rubber, due to its flexibility, high bursting pressure and exceptional resistance to solvents and chemicals. Flare-type injection-molded fittings of the same polymer are used with this tubing to give a completely chemical-resistant system which eliminates the need for critical metals. These flare fittings can be simply applied by flaring the tubing with standard hand tools at room temperature. Some interesting applications include instrumental control lines, water, oil and air lines, chemical conveyance lines and the like.

Extruded sections[3, 4] that are subsequently supercooled and oriented, produce cordage, fibers and cane-like sections that have high tensile strength, long fatigue life, and are well adapted to braiding, weaving, twisting and wrapping. Due to their being, in addition, unaffected by water, oil, gasoline, soap and many other chemicals, and being nonflammable they have found wide application in transportation fabrics, upholstery fabrics, draperies, filter fabrics and rope. Insect screening has been extensively developed and promises to very greatly relieve the load on copper and galvanized screening.

Developments in injection molding of vinylidene chloride resin[5] have produced moldings which have good dimensional stability and freedom from warpage when exposed to varied humidity and temperature conditions. Standard molding equipment with some alterations in the heating cylinder is used. Some of the molding techniques differ somewhat from standard practice because of the crystalline character of the

* Saran Development Laboratory, Dow Chemical Co.

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Tough, extruded saran thread-like fibers are woven into multi-colored fabric patterns and designs in the same way and on the same equipment as cotton, wool textiles

vinylidene chloride polymers. For example, injection molding dies are heated to increase the crystallizing rate of the polymer so that moldings will become hard and stiff in a few seconds and can be ejected without distortion, even at very rapid molding cycles.

Injection moldings have been made as large as 24 oz., and developments promise much larger ones in time to aid the present war effort. These moldings have found use in many industrial applications. Some important fields are chemical processing equipment, the rayon, dairy, automotive and aircraft industries. Plating racks and shields for the nickel and chromium plating industry, containers for medical supplies and pipe and tubing fittings are all adding their weight to the war effort.

Compression molding of vinylidene chloride resin has been started commercially. Sheets for chemical-resistant tank linings are among the important items. Welding techniques have been developed so that large sections can be made by welding together compression-molded sheets, making available blocks for machining special chemical-resistant valves, special fittings and the like. One defense application being developed uses blocks of approximately 150 lb. each.

Pipe has been made available commercially in sizes from $^1/_4$ in. to 2 in. and is aiding materially in the replacement of pipes which have heretofore used critical materials, such as rubber, stainless steel and copper. A complete range of injection molded fittings is available, eliminating more critical materials and enabling the construction of a pipe system of uniformly good chemical resistance.

Film produced from vinylidene chloride polymers, in addition to the good properties mentioned above in connection with other fabricated forms—namely, nonflammability, and water-, solvent- and chemical-resistance—has an extremely low rate of moisture vapor transmission. This property has rapidly placed it in the field of packaging for metal parts for protection against rust during shipment.

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Acrylic resins

THE first year of the war has seen a vast increase in the manufacturing capacity of acrylic plastics as well as an expansion of the facilities for fabricating aircraft parts.

The aircraft industry continues to consume a large percentage of the sheet production, turning out more planes per month and using a larger area of acrylics per plane. New developments in the field include an acrylic power turret which can be revolved mechanically to aim multiple machine guns even in the face of a fast slipstream of air. The guns project through vertical slots reinforced with acrylic ribs so that they can also be aimed through a 90-deg. vertical arc. These acrylic turrets are now standard equipment on all medium and heavy bombers coming off the assembly line.

Our new bombers also carry another acrylic innovation, a gunner's enclosure directly under the tail of the plane. Formerly the most vulnerable point of attack, the rear of these battleships of the air, is now as well defended as the front or side; and like the other gun positions, is protected from the elements by an acrylic sheet enclosure, as are cockpits, observation latches, etc.

The optical qualities of these sheets are amply demonstrated by their use in domes through which plane navigators make their observations. The manufacture of these domes with a minimum deviation of line of sight is probably the outstanding acrylic fabricating accomplishment of the year.

Acrylics have, however, seen active service in all phases of the war effort. The blackout lights on Army jeeps and trucks are being molded from acrylics, tank sight windows are cut from thick sheets, the Navy PT boats have acrylic machine gun housings as well as acrylic windows. Seagoing dials and gages are protected from the effects of salt water by molded or fabricated acrylic covers, usually making possible a waterproof installation and improving visibility.

On the production front, new safety uses of acrylic sheets have been developed. Goggles for welders and guards for shell-loading machines have required large quantities of materials.

The low temperature properties of acrylics have also permitted their use in experimental cold chambers at temperatures far below zero where they maintain not only their transparency, but their high impact strength and durability as well.

New developments in the technique of injection molding methyl methacrylate resins include a variable speed control which can be applied to any injection machine to obtain a stepless range of speeds starting at the normal slow speed and reducing to practically zero. Zone-type control of temperature of mold, whereby different sections of areas of the mold are maintained at different temperatures, are especially desirable for very long pieces of thin cross section, or extra-heavy cross sections, to eliminate folds or weld lines.

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CHEMICAL RESISTANCE OF SARAN PIPE

(At room temperature)

Reagent	*Stability rating*	*Reagent*	*Stability rating*
98% (conc.) H_2SO_4	Good	Ethylene dichloride	Poor
60% H_2SO_4	Excellent	Di ethyl ether	Poor
10% H_2SO_4	Excellent	Dioxane	Unsuitable
35% (conc.) HCl	Excellent	Benzene	Fair
30% H_2SO_4	Excellent	*o*-Dichlor benzene	Poor
10% HCl	Excellent	Ethyl gasoline	Excellent
65% (conc.) HNO_3	Excellent	Turpentine	Excellent
10% HNO_3	Excellent	Triethanol mine	Excellent
Glacial acetic	Excellent	Lubricating oil	Excellent
10% Acetic	Excellent	Linseed oil	Excellent
5% H_2SO_3	Excellent	Bromine water	Unsuitable
Conc. oleic	Excellent	Chlorine water	Unsuitable
50% NaOH	Fair	Bleaching solution	Excellent
10% NaOH	Good	10% Duponol	Excellent
28% NH_3	Unsuitable	10% Zinc hydrosulfite	Excellent
10% NH_3	Poor	15% $CaCl_2$	Excellent
Ethyl alcohol	Excellent	15% $FeSO_4$	Good
Ethyl acetate	Fair	Water	Excellent
Acetone	Fair	Air	Excellent
Methyl iso-butyl ketone	Fair		
Carbon tetrachloride	Good		

Three months of continuous exposure.
The stability rating given is based upon observed changes in color, weight, dimension, tensile strength and hardness of the samples tested.

Extruded saran pipe

(Continued from page 60)

Direct heating methods are ideal for welding in the field. Saran pipe lends itself, under adverse conditions, to this method, for it can easily be welded with use of a gas flame or torch heated unit, against which two pieces of pipe are placed. The general rules of hot plate welding should be observed and great care must be taken not to overheat the plastic material, for this will substantially weaken the welded joint.

Standard welded fittings can be fabricated from the pipe. By cutting on a 45° angle and butt welding on a hot plate, standard welded elbows may be made. A multiple cut weld will also produce an elbow. To make a tee, a 45° cut is first made on one corner of the elbow. Then a piece is welded which has been cut at 45° on the axis of one leg of the elbow.

Saran is adapted to the molding of threaded precision parts (see Fig. 5), and fittings are injection molded of the same plastic material used in extruded tubing. It is important that they be tough, durable and accurate so they will stand up.

4—To weld saran pipe in the field, a gas flame may be applied to a hot disk, taking care not to overheat the material. 5—Injection molded saran fittings are adaptable to threaded precision parts

4

5

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5

6

5—Preparing layup of veneers for hot press with grain at right angle to adjacent layers. 6—Inserting plywood assembly in hot press with film glue interleaved

Aircraft from West Coast

(*Continued from page 69*) essential jobs. The available and suitable press equipment is, therefore, very limited. Such equipment as is available will soon be producing aircraft grade plywood, and a real effort is being made to obtain new equipment for this work.

The size of the required equipment is often the subject of discussion. Suffice it to say at this time that the major portion of the aircraft paneling required today is not over 8 ft. in length, but there is a definite trend toward lengths of 10 and 12 feet. Panel widths seldom exceed 48 in., but here again we find a trend toward 54-in. widths.

Fabricating plywood veneers

Veneers for aircraft plywood are sliced very thin: $^{1}/_{16}$-in. veneer, considered very thin for commercial paneling, is very nearly the maximum permissible thickness in aircraft grade plywood. The most frequently specified thicknesses are between $^{1}/_{50}$ in. and $^{1}/_{30}$ in., although in a few instances veneers must be as thin as $^{1}/_{100}$ in. or as thick as $^{1}/_{10}$ inch. Veneers must be cut smoothly and without rupturing the wood structure. Uniformity of thickness is important too. A tolerance of $^{2}/_{1000}$ in. is expected of veneers $^{1}/_{48}$ in. thick, and a variation of more than $^{5}/_{1000}$ in. in any thickness is very undesirable. Seaming of the blocks or cants is, therefore, quite desirable. Because the veneers come from vertical grain (VG) cants, they are comparatively narrow, seldom more than 10 in. wide. It obviously is impossible to handle these veneers on high-speed belt conveyors as in commercial plywood processes.

Drying of the thin veneers is accomplished slowly and at relatively low temperatures. Drying must not impair the strength of the wood, and end-splits and cupping must be avoided. Furthermore, the final moisture content must be controlled to within 3 percent. That is, the final moisture content may range between 7 percent and 10 percent, but not between, say, 6 percent and 11 percent.

Because the veneer strips are quite narrow (4 in. to 10 in.) they must be joined edge-to-edge to make up sheets as wide as needed—seldom over 5 ft. in width, although wider sheets are occasionally required for diagonal or short-way-grain paneling. The edge joints must be perfectly tight and well glued in the finished panel. Making uniformly tight joints requires first of all that a perfectly straight edge be cut and cut very cleanly. For this work, edge jointers with high-speed cutter heads are used. Clippers or "guillotines" have not been found satisfactory, except as a means of preparing rough edges for jointing with a minimum loss of veneer.

After the straight edges have been cut, the veneers are promptly moved to the edge-gluing machines. Two methods of edge-gluing are used, both involving the application of adhesive to the veneer edges: one involves application of thin paper tape, while the other "sets" the adhesive so that taping is unnecessary. Paper (gummed) tape is allowed only on the outside of the outer veneer plies, never on interior plies. After the panel is completed, the tape must be soaked and brushed off, not scraped or sanded. Because removal of the tape is time-consuming and troublesome, and "tape marks" or depressions often are left on the panel, this method is rapidly being replaced by so-called "tapeless splicing."

Edge-to-edge gluing is accomplished without the aid of paper tape by the use of machines especially designed for this work. These machines are called "tapeless splicers" or "edge-gluers." Up to the present time, these edge-gluers for thin veneers handle the veneers in a horizontal plane, and movement is parallel to the edge or joint. An adhesive, usually of the urea-formaldehyde type, is applied to the veneer edges; and the machine applies heat while the edges are held together long enough to cause the adhesive to harden or set firmly, thus holding the veneer strips together. Tapeless splicing is definitely preferred for two very good reasons: first, it is the cleaner method; second, there is no tape mark or depression along the edge joint—and this is important when we remember that a thickness tolerance of only $^{7}/_{1000}$ in. is allowed in a $^{1}/_{16}$-in. (.063-in.) plywood panel.

Having selected the veneer, edge-jointed and edge-glued it into sheet form, the next step is that of making up the panel. Thin panels are made up of three sheets of veneer: face, core and back. Panels $^{3}/_{16}$ in. and thicker are made with 5 or more veneer sheets (plies). Panels having as many as 15 plies are not uncommon, although the total thickness seldom exceeds $^{3}/_{4}$ inch.

Selecting an adhesive is an extremely important step. The choice is influenced by the fact that the final panel must be able to withstand submersion in boiling water for three hours and then meet a specified strength in a tensile shearing test. Another factor to be considered is the effect of liquid adhesives on thin veneers. Coating thin veneers with a liquid adhesive is extremely difficult, particularly in roll-coating type glue spreaders, and veneers are too often broken in this process. Wet glues cause veneers to swell, usually unevenly, making them wavy and difficult to handle. (*Please turn to next page*)

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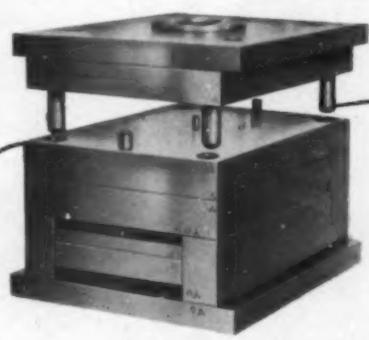

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The obvious solution to this problem is the use of an adhesive in dry film form. This film glue comprises an extremely thin sheet of tissue paper impregnated and coated with a phenol-formaldehyde resin adhesive. Only the truly weatherproof, indefinitely durable adhesives are permitted in aircraft plywood, and regular and frequent inspection of glue-joint quality is mandatory.

One type of phenolic glue film is furnished in rolls of two different widths: 50-in. and 74-inch. Each roll contains 16,000 or 19,000 sq. ft. of film. The film is .0035 in. thick and weighs 11.5 lb. plus or minus 0.5 lb. per 1000 sq. feet. It requires that the veneers have a moisture content of between 7 and 10 percent. Obviously, then, it solves one of the most difficult manufacturing problems—control of the amount of adhesive applied.

Presses with heated plates are used. The hot-plate presses have from 4 to 15 openings, and each opening is charged with one to a half-dozen panels. The number of panels made in each opening is influenced by a number of factors, e.g., panel thickness, veneer flatness and so forth. The optimum "stack" for each press opening is approximately $^5/_8$ in.; but the condition of veneers often makes it advisable to use stacks of less than $^1/_4$ inch. Because the veneers are thin, many operators support them on thin "caul boards" of metal or thin plywood. Cauls also serve to insulate the outer veneers from the hot press plates, thus avoiding excessive heating before full pressure can be applied. However, when the presses can be loaded and closed with sufficient speed, the use of cauls is not absolutely necessary.

Each panel produced must be perfect. Aircraft plywood is a precision product. The total thickness is specified, but so also is the thickness of each ply in the panel. The strength of the glue joint under very severe test conditions is specified, but so also is the strength of the wood itself.

Aircraft plywood is intended to be a carefully engineered product, and for obvious reasons it must measure up to definite strength standards regardless of where it is made. Sheet metals, regardless of the mill from which they come, can be depended upon to have the specified strength properties and thickness. This is the goal of those who make aircraft grade plywood: a thoroughly dependable product, made to engineers' specifications of weight, thickness, strength and durability. When this is reached, aircraft designers and engineers will be able to utilize the advantages inherent in plywood. Pound for pound, a plywood panel is much stiffer than a sheet of the lightest metal, and stiffness is an extremely important factor in structurally important aircraft material.

Plywood can be used in large sheets that are either flat or curved, or compound-curved like the shell of an egg. This reduces the number of necessary joints as well as the total man-hours required on the assembly line. Further, plywood does not require fastening by rivets, thus leaving the outer surface smooth, lacking in wind drag.

There are many advantages inherent in plywood, and these are being used to an ever increasing extent, particularly in military aircraft. Plywood is not just a substitute for metal. It can perform many functions which metals are unable to compass. The extent to which plywood finally assumes its rightful place will depend, naturally, upon how uniformly reliable it proves to be in service. This imposes a tremendous responsibility upon all who aspire to manufacture aircraft grade plywood.

BUY WAR BONDS AND STAMPS

Redwood wheels

(***Continued from page 81***) and reloading. Figure 13 shows the molded wheel after the flash has been brushed off.

The flash lines are then sanded and the entire wheel is buffed and polished, thereby eliminating any sign of the mold parting lines. The wheels are then ready to travel on an overhead conveyor system to the paint department.

In this department the wheels are first given a prime coat and then a final or finish coat. Even at this point efficiency is the watchword, for not only do the wheels reach the spray booths on a conveyor system, but they are carried through the spray booths and on into the drying ovens on this same automatic system. The spray booths, being water-washed, permit salvaging of 25 percent of the paint used (Fig. 17).

The conveyor system (Fig. 16) carries the wheels through a final inspection department where powerful lights and watchful eyes reject any wheels with defects. Having passed this final inspection, the wheels are packed for shipment.

This entire point system is geared to a production of 7000 finished wheels per eight-hour shift, but can handle any smaller production with little loss in efficiency.

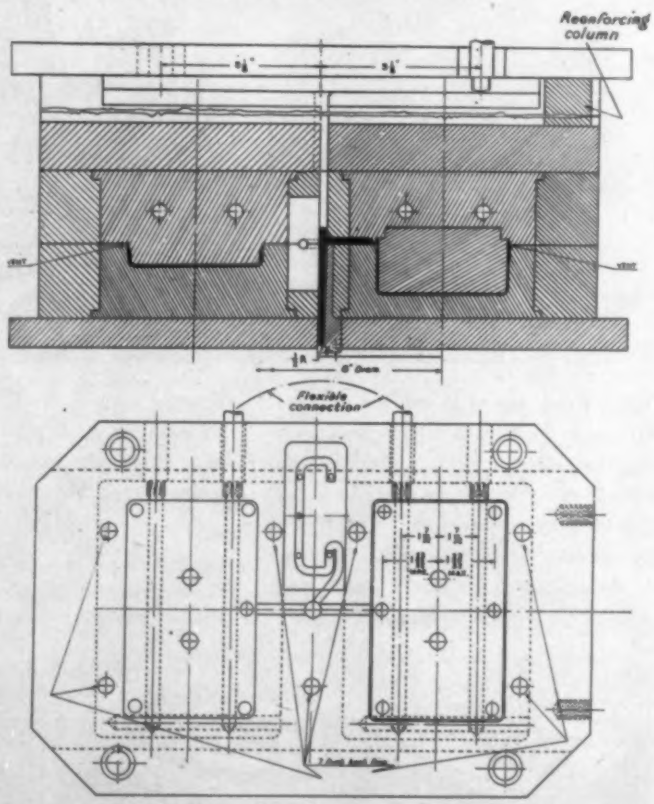
First aid carrier

(***Continued from page 52***) it fit the injection molding machine. This may be seen from the mold drawing below.

The molding of the handle was cleverly done by gating it on the end which is inserted in the metal retaining clips, out of sight. Thus the molder speeded production by not needing any finishing operation on this piece.

On one side of the finished kit are two swinging metal clips from which the case may be hung when it is not being carried by the handle.

Credits—Material: Lumarith. Kit parts molded by Elmer E. Mills Corp. for U. S. Air Conditioning Corporation

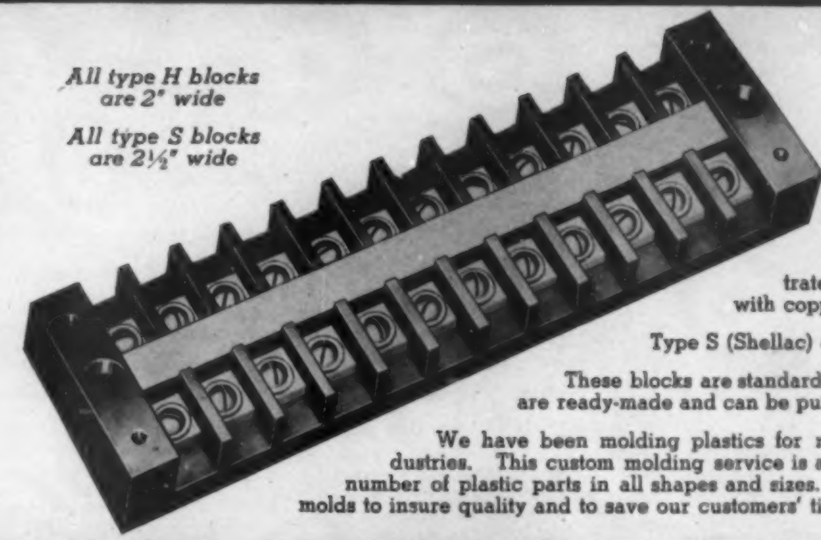


3 CAV. COMBINATION MOLD
FIRST AID CASE & HANDLE

STOCK MOLD TERMINAL BLOCKS

All type H blocks are 2" wide

All type S blocks are 2½" wide



Standardized, *stock-mold* terminal blocks to serve all war industries quickly and efficiently are in steady production at Insulation Manufacturing Company's plant.

Type H (Bakelite) comes in four sizes: 4, 6, 8, and 12 terminals. The 12 terminal block illustrated has the white marking strip. It is also available with copper grounding strip and plastic covers.

Type S (Shellac) comes in three sizes: 4, 8, 12 terminals *only*.

These blocks are standard circuit connectors in many industries. The molds are ready-made and can be put on presses to deliver any quantity.

We have been molding plastics for more than 50 years to specifications for all industries. This custom molding service is available to all essential industries to produce any number of plastic parts in all shapes and sizes. We design and construct all our own tools and molds to insure quality and to save our customers' time.

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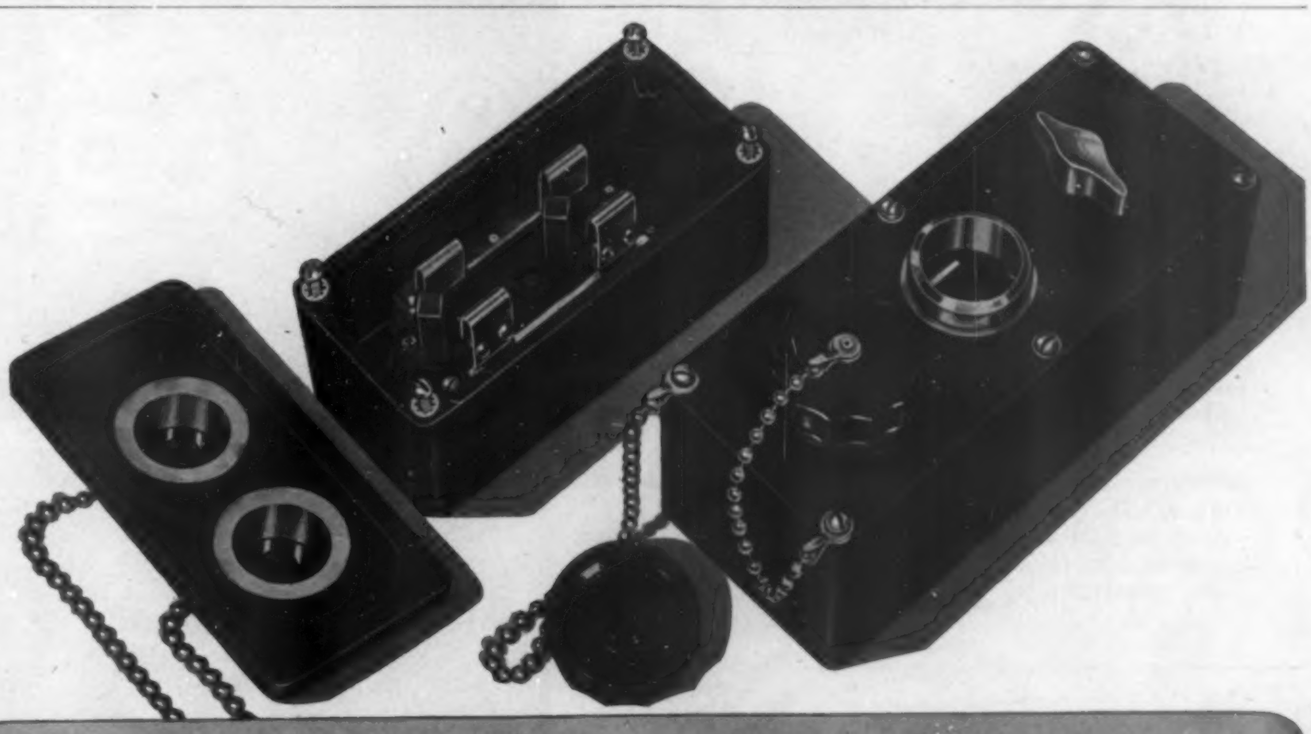

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Phila.: Paragon Sales Co., Inc. Chicago: Steel Mills Products Co., Inc.

Woman power in plastics

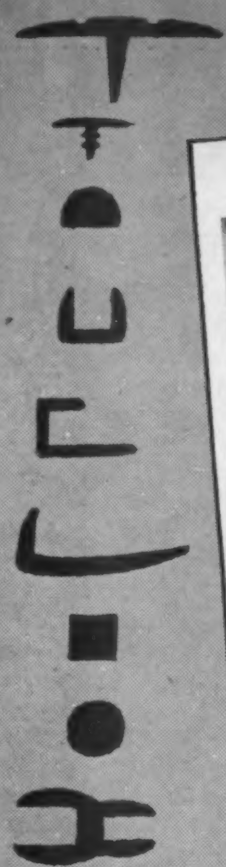
(*Continued from page 65*) same amount of pay because the job has been simplified. Careful records of such job simplification should be kept in case of future disputes.

Uniforms for women are subjects of much discussion, with some employers preferring them and some not. In the plastics industry a uniform coverall furnished by the company has been found most desirable—if any uniform is to be used. Usually, women will wear a sweater or some long-sleeved garment over or underneath this coverall. As a general rule, elbow length sleeves or no sleeves at all are preferable in coveralls.

Certain chemical plants found uniforms to be of distinct value in the morale of women workers. In the photograph below is a uniform especially designed for women in the Monsanto Chemical Co. plant in St. Louis. This incorporates

Dressed for their jobs, laboratory (top) and mechanical workers (bottom) wear uniforms that combine safety with smartness. Two-piece slack suits with caps to match are made in many colors, one for each department

PHOTOS, COURTESY MONSANTO CHEMICAL CO.



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This valve, shown below, handles air, water, or oil, up to 6,000 lb. per sq. in., *without shock*. Plastics plants, everywhere, are using it. It is backed by a company that has specialized in regulating valves for nearly a half century.

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☐ Thermostats
☐ Balanced Valves
☐ Control Valves

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● When the mailed fist of War threatened American production facilities no less than our fighting forces, among the first to accept the challenge was America's youngest industry . . . *Plastics!*

How well you of that industry pitted your knowledge and ingenuity against our common enemies can never be completely told until Johnny comes flying home. And you may be sure that Johnny and hundreds of thousands like him will do the telling. For theirs will be the stories of the remarkable plastic war products you have produced—plastics which not only replaced vital and essential war metals but did the job better. Their recognition of this fact is today already laying the foundation for a greater acceptance of plastics in the scheme of things to come.

If you are one of the manufacturers extending the ways in which Plastics are serving our armed forces, you may have need of the broad, practical plastic finishing knowledge presented by McAleer's *Plastic Finishing Division.*

Write us. We'll be glad to furnish the details and characteristics of McAleer *Quality-Controlled* buffing and polishing compositions. Better yet, send samples of work together with an outline of the finish you desire.

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●

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Quality-Controlled Finishing Materials
ROCHESTER, MICH.
PLASTICS FINISHING DIVISION ★ ★ ★

all the desirable style features as well as the protective features of a covering garment.

Contrary to what a lot of employers expected, the absenteeism among women has in the plastics industry proved to be less than that among men. Perhaps the reason for this is the possibility of being drafted which makes men want to have a fling while they can, whereas women realize that they are on the job for the duration.

There is a definite handicap in hiring women for certain jobs in the plastics industry involving heavy lifting operations. It is also true that the heat of the press room often causes extreme fatigue among women and many find themselves unable to adjust to such work. Both of these factors may be overcome to some degree through the breaking down of jobs into multiple operations and having the lifting part of the operation done by a man or by several women; and by having adequate rest periods for overcoming the heat factor. Installing of water fountains or cold soft drink machines at centrally located spots throughout the plant will also tend to cut down loss of efficiency through heat fatigue. One plant has even found it pays big dividends to have a travelling water boy go through the plant.

The split shift as an experiment may be tried in several plastic plants in the near future. It is thought that by announcing a four-hour shift, local housewives in the community may be attracted, since they would also be able to do their housework, and not have to be on their feet so long.

What jobs can women do?

Women can be used on a great variety of jobs in the plastics industry. For the purpose of this article, a survey of jobs being done in the industry by women has disclosed that the following are being done successfully:

Finishing—Women run drill presses, grinders, lathes, sanders, tapping machines, automatic machines, multiple spindle drill presses, buffers, paint sprays, hand tools, files, chisels, scrapers, reamers, flexible shaft machinery.

Inspection—Women operate thread gages, plug gages, ring gages, snap gages, multiple gages, dial gages.

Tool room—Women run polishing machines, shapers, lathes, grinders, drill presses and do hand operations on the molds.

Press room—Women run light hand molding presses; single ram presses from 3 to 15-inch; double ram presses from 6 to 8-inch; assemble and disassemble wedges; do pre-inspection and floor inspection; hi-spot testing.

Drafting room—Women do ordinary drafting room work.

Laboratory—Women chemists do the same sort of work that the men do.

Designing—Women artists do plastics designing.

One plastics mold maker has been extremely successful in using women in its tool rooms. These women work on all types of mold operations including cutting, grinding, polishing and all the various steps of tooling molds. The company has an extensive training program for women which is especially designed to fit tool room work as distinguished from a general training program applicable to the entire industry.

It is quite evident that employing women involves factors to which management has not given too much attention prior to the war. British experience and the experience in this country are sufficient to show how well women do jobs in industrial plants. They do require different handling, and different techniques for doing heavy jobs must sometimes be devised, but they are not so difficult to work with as to make it

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Increasing daily is the already large number of functions in which plastics excels glass, ceramics, metal, wood, rubber. Thousands of articles previously limited to these materials are certain to appear on the market done wholly or partially in plastics after the war is over. To look into plastics now is to be *forearmed!* Let's get started . . .

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for prompt estimate if they include plastics or if plastics can be used to advantage. Though our capacity is always full, new runs are needed to replace old — and they must be scheduled a long way ahead. However, if you can not at present use plastics, our engineers will be glad to plan with you about your place in a World of Plastics already coming rapidly at us!

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non-feasible to hire them in the plastics industry. One personnel manager in a laminating plant said that he considered women as being small men insofar as handling their jobs was concerned. They do not have great physical strength, they cannot lift heavy weights, and they fatigue more quickly, requiring more rest periods. But with all that, he declared that pound for pound a woman does as good a job as or better than a man in the factory once she is trained.

It is a challenge to the plastics industry's productive ingenuity as its man-power is slowly drained—a challenge which cannot be ignored and which must be successfully met.

• • •

In connection with the article on the employment of women in the plastics industry (see page 60), the following radio interview with Viola Palmgren Makeever, of the Makalot Corp., is of interest. In a Blue Network program entitled "The Woman of Tomorrow," Nancy Craig asked Miss Palmgren something about the nature of her work in plastics and how she came to enter the field. The following are extracts from the interview.

Craig: We have been hearing a great deal lately about plastics. Every time we shop for some of the articles we need and use every day—combs, brushes, cosmetic containers and many others—we are told that they are plastic. I know that something made of plastic is molded, but beyond that my knowledge is extremely limited, and so I welcome our guest this morning, Viola Palmgren Makeever. Miss Palmgren is the operating superintendent and one of the owners of the Makalot Corp., a manufacturer of the molding powders which go into the manufacture of the plastic articles we use. Will you tell us, Miss Palmgren, how you happened to become interested in plastics?

Palmgren: It was through my brother. About 15 years ago he was working in a small factory in Massachusetts. This company was attempting to produce certain materials which would be suitable for the manufacture of amber beads, cigarette holders and similar small articles. Every afternoon I used to go to the factory where I helped in cooking the combinations—chemical combinations. Perhaps this cooking with the test tubes and miscellaneous laboratory apparatus fitted into the general groove of my previous life, since I was the eldest daughter in a family of six and naturally I had absorbed considerable experience as a cook. Possibly it was just a natural liking for experiments. Anyway, the chemist at the factory was a failure, and after the company was unable to find chemists from Harvard, Yale, Massachusetts Institute of Technology and other colleges who could complete the missing links, I was given my chance.

Craig: Well, at that time did you anticipate the great development of the plastics industry, or was it still in its infancy?

Palmgren: At that time none of us had any idea of the way the plastics field would boom. All I was interested in was discovering some material that might serve as a suitable basis for manufacturing clear, substantial and beautiful jewelry—and of course I wanted to help my brother.

Craig: From your mention of test tubes, Miss Palmgren, I

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judge that considerable knowledge of chemistry is necessary in your work. Did you specialize in chemistry at college?

Palmgren: No, I didn't, although later I did take courses in chemistry at Massachusetts Institute of Technology and enjoyed them. In fact, I guess I rather lean to test tubes and experiments.

Craig: And you apparently have the idea that the element of cooking is important in the manufacture of plastics, just as it is in the home?

Palmgren: Certainly. Even the equipment is similar. To illustrate, both the plastic material manufacturer and the housewife use cooking utensils such as kettles. To be sure, the plastics kettle is many times the size of that used in the home, but nevertheless the basic use principles are the same.

Craig: About how large are the kettles used for mixing plastics?

Palmgren: The sizes vary. A typical kettle would be about 5 ft. in diameter with a capacity of about 650 gallons. But that isn't quite the sort of kettle we started with—things have changed a bit since the days of the old factory down by the railroad tracks. It was lonely and dirty and unsatisfactory in every way. In fact, as I look back on it, it was mighty dangerous.

Craig: Who did all the heavy work of moving those big kettles around, and so on?

Palmgren: Oh, I did my share. Of course I can't lift by hand a 300-lb. drum, but I can use a hoist as well as anyone. I don't know of anything about a plant that I can't do.

Craig: Of course your own career has proved it, but on the whole, do you think that women are capable of becoming good plastic chemists and operators?

Palmgren: I see no reason why they should not. Of course, not every woman is willing to go through the day with black hands and face, with woodflour in her hair, wearing perhaps as I do, heavy overalls and a cap; but if she is really interested in plastics, she will have a world of fun, and find tremendous interest in delving into the almost unbelievable possibilities of plastics.

New uses for resin board

(*Continued from page 57*) The recent development of a brown-colored molding board offers, this year, styling opportunities not possible before. For example, this new material is being used in combination with the standard black for industrial goggle frames (see Figs. 4–7). Developed jointly by the goggle manufacturer and the material supplier, the molding process utilizes strips of resin board .031 in. thick, 2 in. wide and 15 in. long. One side of the rectangular strip is cut to a predetermined shape which follows roughly the contour of the goggle frame. These strips are first dampened by immersing in water and, while wet, each is coiled to form a roll about 2 in. in diameter. The coils are then placed in a form to hold their shape, and dried. After drying, each preform—as these coils now have become—is ready for molding without any additional preparation or material. Rings that hold the goggle lenses in position are molded from flat sections of resin board, stamped out approximately to the shape of the finished part.

Food trays originally made from aluminum and later from hard rubber now are made comparably tough, and equally easy to keep clean and sanitary, by molding them from resin boards or blanks. In order to assure maximum toughness and dimensional stability, as well as resistance to food acids and alkaline washing compounds, a unique procedure has been developed for the fabrication of these trays. Boards or

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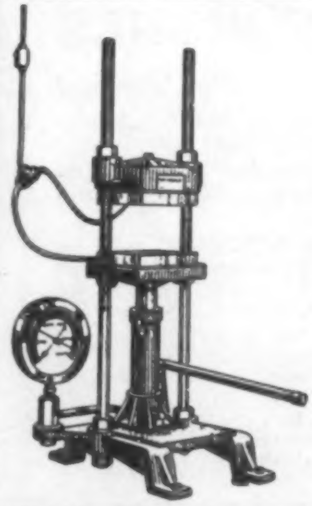

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THE MEARL CORPORATION
153 Waverly Place New York, N. Y.

blanks of a size that allows 1/2-in. flash all round are immersed in water until they have absorbed about 15 percent moisture. The dampened sheets are cold-pressed under 50 p.s.i. pressure to the shape of the tray. A wooden mold is used for this preforming operation. The preformed sheets are then dried to a moisture content of 3–5 percent. Two of these preformed sheets are required for each tray. One serves as the surface sheet, the other as the backing sheet. Next step is to spray the face of the surface sheet and the back of the backing sheet with a slurry of phenolic molding material ground into a solvent. The spray-coated boards are then dried to the molding volatile content of 4 percent maximum. Two of the coated and dried sheets are loaded into the mold and subjected to pressures of 1000–3000 p.s.i. and molding temperature of 300° F. After it is taken from the mold, the tray is ready for use when the flash has been removed.

Machetes have, for a number of years, employed handles molded from resin board blanks because they are highly resistant to impact and do not shrink or swell in sweltering heat and humidity. However, since Pearl Harbor, these tools have assumed a more serious rôle as general utility knives used by the armed forces. Offshoot of this application is the development of molded handles for Army mess kit knives (Fig. 2), prompted by the shortage of aluminum used previously. Molding blanks were chosen because they provided mechanical strength comparable to that of metal and were readily adapted to high-speed production in multiple-cavity molds. The plastic handles require little finishing.

These are only a few examples of wartime applications of phenolic molding blanks. Many others are constantly being developed. For instance, blanks were incorporated as one integral unit with steel and three types of rubber to form oil seal rings on propeller units. In another case, they were used in the production of machine-gun elevating levers in place of metal. Readily assembled in the mold, they assure rapid production of other vital parts with minimum outlay in tools.

Credit—Material: Bakelite phenolic resin boards.

Producing mortar shell fuzes

(***Continued from page 73***) of burr or fin which might wedge the internal mechanism. The cleaning set up is shown in Fig. 6. Parts are spindled and the outside burrs removed on the spindles and motor-driven brushes shown in the foreground. The parts are then drilled in three places in the automatic Bodine machine. It is necessary to invert the parts on their stations to complete the drilling from the other end, as can be seen in the figure. The parts are then further burred and scraped on the inside holes to remove all flash and burrs.

One of the inspection tables is shown in Fig. 7. Here all six of the threads are gaged 100 percent, in addition to the diameters of six holes, the height of the slider cavity and the overall height. The threads, inside diameters and overall heights of the heads and booster cups are also gaged 100 percent. Such extensive use of thread gages and plug gages has proved a difficult problem in maintenance. Ring gages require adjustment approximately every 25,000 parts, and are completely worn out in approximately 100,000 parts. Plug gages cannot be adjusted and hence necessitate replacement every 100,000 to 200,000 parts gaged. The rate of wear is largely determined by the fit of the molded part. It is highly desirable to keep the pitch diameters so the parts will allow the gage to turn freely.

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Low pressure laminates

(*Continued from page 55*) but the thing we are most concerned with is the end result rather than the rules that govern the process.

It is very difficult to go into the exact methods of fabricating and laminating by our process. We found the most interesting part of our work to be the discovery that no two parts can be fabricated in the same manner. Each part has its own specific problems and only some basic rules that gradually evolve can be applied.

In general, the type of aircraft parts that have been molded to date includes wheel well assemblies, fairings, cover plates of all types and descriptions, step wells, flare tubes, spoiler tabs, gasoline tanks, and the like.

It can readily be seen that most of these parts are subjected only to wind loading and are of a non-structural nature. Our next step, of course, will be structural parts. Before these can be attempted, sufficient engineering data must be accumulated, and this information is about complete.

The first year of war

(*Continued from page 51*)

Birmingham—700 Frank Nelson Bldg., Birmingham, Ala.
Boston—Room 1501, 140 Federal St., Boston, Mass.
Chicago—38 South Dearborn St., Chicago, Ill.
Cincinnati—831 The Enquirer Bldg., Cincinnati, Ohio
Cleveland—1450 Terminal Tower Bldg., Cleveland, Ohio
Detroit—1832 National Bank Bldg., Detroit, Mich.
Hartford—95 State St., Springfield, Mass.
New York—Room 1815, 80 Broadway, New York, N. Y.
Philadelphia—Room 1300, Mitten Bldg., Broad and Locust Sts., Philadelphia, Pa.
Pittsburgh—1202 Chamber of Commerce Bldg., Pittsburgh, Pa.
Rochester—1238 Mercantile Bldg., Rochester, N. Y.
St. Louis—935, U. S. Custom & Courthouse, St. Louis, Mo.
San Francisco—402 Hotel Empire, San Francisco, Calif.
Los Angeles—409 Chamber of Commerce Bldg., Los Angeles

To utilize plastics more extensively and more effectively in the war effort, redesigning may be necessary. Frequently the mere copying of a design of an object converted from metal to plastics causes waste of material and waste of hours. For example, a gun barrel sighter for the Garand rifle made of brass, involving five pieces and two soldering operations, was easily converted into plastics. In the original conversion, the design of the brass piece was just copied. Upon further examination, the plastic gun barrel sighter was redesigned to make a two-piece operation which speeded up production and saved material. The original plastic gage cases for shipboard use were copied from the brass design and proved none too satisfactory. However, upon redesigning to utilize the best points of plastics molding and plastics properties, these cases proved more satisfactory than the original brass cases. This point of redesign is extremely important and should be kept in mind when conversions are being effected.

Utilizing present capacity

Reproduced elsewhere in this article are tables, compiled by the Conservation Section, Industry and Facilities Branch, Division of Statistics, from data reported on Form WPB-1251, submitted by manufacturers of plastic parts. A projection of the figures given in these tables into the future

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illustrates the need for a re-evaluation of the plastics industry's place in the war.

The increasing use of plastics for war matériel is encouraging as a picture of how essential the industry is to the nation's economy. But there is still plenty of room for increased usage of plastics. For example, as of September 30, 1942, 18.2 percent of the cold molding industry was still working on orders bearing absolutely no priority rating. Extrusion plants were working 27.2 percent on unrated orders, and in the compression molding field, 40.8 percent of the industry was still working on unrated orders as of September 30, 1942.

This must be stopped. Again the reason is obvious. With the sharp upswing in essential war applications, as demonstrated by the analysis of work being done on A-1-k ratings and higher, it is certain that every pound of plastic material will eventually be needed for war.

The mere fact that at the present time we have a slight excess of materials does not make it follow that that excess should be used in nonessential applications. If a man makes $5000 a year and has $10,000 in the bank, he cannot long continue to spend $7000 a year, drawing on his reserve. At the present time that is the position in which the plastics industry finds itself—drawing on reserves—and those reserves will be needed much faster than had been expected.

This does not mean that presses which have been working on non-essential jobs will have to be shut down. It simply means that greater and greater effort must be expended to convert those presses to work on high-rated orders.

The extent of operation of machinery in the plastics industry appears to indicate that little additional capacity is required except in certain specific instances where a particular plant might need one or two presses to carry on its particular type of work without any stoppage. For example, during the payroll week ending nearest to June 30, 1942, compression presses were being operated only at 51.1 percent of maximum capacity. Injection molding machines were operating at 53.2 percent of capacity as of the same date, and extrusion molding machines 41.01 percent. Cold molding presses of the mechanical type were operating at 26.2 percent of capacity, and the hydraulic type were operating at 34.7 percent of capacity.

This statistical information clearly indicates one fact, and that is that a greater effort toward sub-contracting must be made in the industry. This will utilize present plant capacity effectively and avoid increasing the amount of already underworked machinery.

In sub-contracting, the prime contractor must take the viewpoint that the sub-contractor is essentially a department of his—the prime contractor's—own plant. As such a department, the sub-contractor must receive the benefit of all the technical "know-how" or molding experience which the prime contractor has. A prime contractor who successfully sub-contracts work never allows his sub-contractor to go on a sink or swim basis.

It is probable that the War Production Board will clamp down on the manufacture and delivery of new machines since the Conservation Section's survey shows much idle capacity. This means that molders, in figuring how to do certain jobs, may find themselves lacking machine capacity in their own plants to do one or two operations on the job. Obviously, if new machinery cannot be obtained, the only answer is to sub-contract those parts of such jobs to the plant which has such machines, so sub-contracting looms larger and larger as a method of increasing the use of plastics for war.

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Restrictions of critical materials have sent the ball right into the plastic molder's hands. It's his game if he will only keep his product up to the high standards of accuracy and strength needed for today's requirements. It is of utmost importance, therefore, that he follow implicitly the powder manufacturer's instructions as to temperatures and duration of cure. Use the *Cambridge* Pyrometer to check temperatures of molds, rolls and masses. This accurate, rugged, quick-indicating instrument is ideal for shop use. Powder manufacturers recommend the *Cambridge*.

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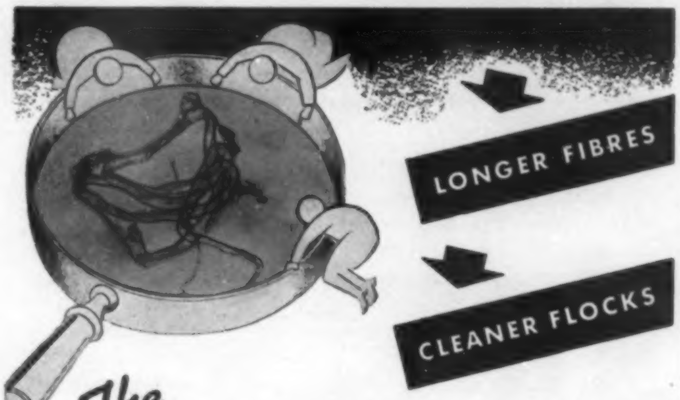

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This comprehensive book gives all who are interested in the designing of industrial products, a clear, detailed picture that will enable them to evaluate plastic materials in relation to the particular design problems at hand. For convenience it classifies plastics on the basis of their origin and whether they are thermosetting or thermoplastic. Many examples of plastic designs are illustrated, as well as described. All data have been taken from reliable sources and have been doubly checked by many experts. **SEE IT 10 DAYS FREE**

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INJECTION AND COMPRESSION MOLDING

1919 RECTO IS 24 YEARS OLD 1943

In the plastics picture

(*Continued from page 118*)

★ ACCORDING TO INFORMATION RECEIVED FROM the publishers, the looseleaf Abstract Service covering Resins, Rubbers and Plastics, edited by H. Mark and E. S. Proskauer, and published by Interscience Publishers, Inc., 215 Fourth Ave., N. Y. C., which was reported in our April 1942 issue, was very well received by industry, as well as by Government and educational institutions. Eight issues have appeared as of August 1942, including abstracts from German periodicals which are not available in this country.

★ BAKELITE CORP., UNIT OF UNION CARBIDE AND Carbon Corp., has announced the addition of Lloyd H. Wartman to the Research and Development Laboratories in Bloomfield, New Jersey. Mr. Wartman is a graduate of the College of St. Thomas, with a B.S. degree.

★ A NEW WATERPROOF, PROTECTIVE AND ABRASION-resistant mask for plastic bomber noses and windshields simply sprays on . . . and peels off. Adhere, Inc., of Los Angeles, manufacturers of edge-gummed masking paper and special insignia masks, announce their Spraymask, which is applied with an ordinary paint spray gun (above), and afterward may be peeled off in a sheet. Aircraft companies who have been experimenting with it are reported to have found it adaptable for spraying formed plastic glass parts, such as bomber noses and gun turrets, to protect them until the plane is on the line ready to fly. Although primarily used by aircraft plants the spraymask is claimed by the manufacturers to be adaptable to other types of production requiring a temporary protective mask or coating against paint, grease, abrasion, wind or weather. Its appearance while being sprayed is semi-cloudy, but the mask dries clear and transparent. For continued protection against weather, the mask may be left on for weeks after all painting and camouflaging are completed, until the plane is ready to fly.

★ J. R. McCANN, PRESIDENT OF PLASTIC TURNING Co., plastic fabricators of Leominster, Mass., died suddenly in Boston on November 28.

★ LOUIS W. HOFFMAN, NIGHT SUPERINTENDENT OF the Formica Insulation Co., Cincinnati, Ohio, died suddenly at his home on December 6. Mr. Hoffman had been associated with the Formica company since 1918.

Classified Advertisements

All classified advertisements payable in advance of publication. Rates: $5.00 up to sixty words; enclosed in border, $10.00 per inch. Publisher reserves the right to accept, reject or censor all classified copy.

WANTED: THERMOPLASTIC SCRAP or rejects in any form, including Acetate, Butyrate, Styrene, Acrylic and Vinyl Resin materials. Submit samples and details of quantities, grades and color for our quotation—Reply Box 508, Modern Plastics.

WANTED: PLASTIC SCRAP OR REJECTS in any form, Cellulose Acetate, Butyrate, Polystyrene, Acrylic, Vinyl Resin, etc. Also wanted surplus lots of phenolic and urea molding materials. Custom grinding and magnetizing. Reply Box 318, Modern Plastics.

FOR SALE: 1—24" x 24" Southwark Hydraulic Press, 4-openings, 14" rams; 1—#1 Banbury Mixer; 1—Hydro-Accumulator 2500 PSI, 16—½ gals., complete with tank, compressor and piping; 1—W.S. 15" x 18" Hydraulic Press, 10" dia. ram; 2—D. & B. 20½ x 20½" Platens; 1—W.S. 30-ton Broaching Press, 7" ram; 1—16" x 18" Press, 10" ram; 1—14" x 15 1/2" Press, 10" ram; 13—24" x 55" Steel Cored Heating Platens; 1—Stokes "N" Pilling Machine; 1—Farrell Birmingham 16" x 36" Rubber Mill; 4—W. & P. Mixers; 1—Triplex Hydraulic Pump, 11 g.p.m. at 2000 # pressure, also others; 1—W.S. Hand Pump; 1-set of Compounding Rolls 18" x 44"; Adamson 6" Tuber; Dry Mixers, Pulverizers, Grinders, etc. Send for complete list. Reply Box 446, Modern Plastics.

WANTED: Hydraulic Presses, Perform Machine and Mixer. Stainless Steel or Nickel Kettles, Vacuum Pan. No dealers. Reply Box 275, Modern Plastics.

FOR SALE: 350 Ton Hydraulic Lead Wire Extrusion Press with Pump. 400 Ton Horizontal Hydraulic Extrusion Press. Hydraulic Scrap Baler, 80 Ton, 6½" Ram, 90" stroke, 5000 lbs. per sq. in. Large stocks of Hydraulic presses, pumps and accumulators, preform machines rotary cutters, mixers, grinders, pulverizers, tumbling barrels, gas boiler, etc. Send for bulletins #138 and L-17. We also buy your surplus machinery for cash. Reply Box 439, Modern Plastics.

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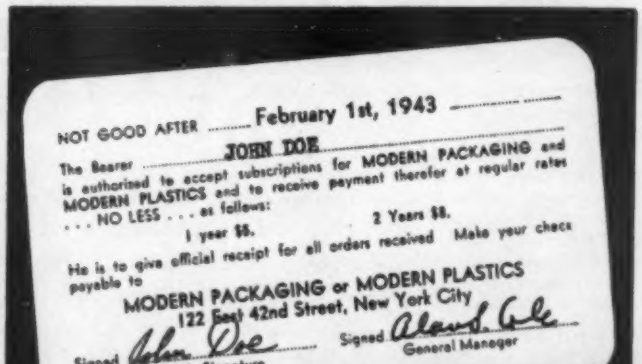

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WANTED: Injection molding Machines, Reed-Prentice preferred. Give full particulars as to make, age, size, serial number, condition and price. Graphic Arts Laboratories, 549 W. Randolph St., Chicago.

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SALESMAN: Young man interested in investing capital in progressive compression or injection moulding plant. Has excellent following for post-war items as well as ability to obtain Government contracts. A personal interview would be appreciated. Reply Box 689, Modern Plastics.

WANTED: Injection Moulding machines, 6 and 8 ounces capacity preferred. Plastic extruding machines, medium size, complete with the auxiliary equipment necessary for operation. Automatic and semi-automatic compression moulding presses, capacity range 15–100 tons. Reply Box 684, Modern Plastics.

FOR SALE: Large steam drying unit for plastics, enamels, paints, varnish, etc. Capacity 25 M cubic feet. Could be used for heater. Bargain. JOHN H. TALGE, 2040 N. Delaware St., Indianapolis, Ind.

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SITUATION WANTED: Mechanical Engineer. 10 yrs. in molding industry. Experienced in design of compression, injection and extrusion molds. Now employed by Molding Co. Want to change. Interested in design or supervisory position. West coast preferred but not essential. Reply Box 678, Modern Plastics.

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WANTED: One vertical two ounce De Mattia injection molding machine. Write, giving full particulars as to manufacturer's serial number, age, condition, price. Reply Box 687, Modern Plastics.

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TO EXECUTIVES OF THE PLASTICS INDUSTRIES: Available—young woman with through knowledge of plastics—design and application. Background, creative and promotional. Lectured on the origin and development of plastics relating to present conservation needs and future living. Willing to be groomed for any vital job requiring intelligence and enthusiasm. Three times 1st award winner. Reply Box 690, Modern Plastics.

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Modern Plastics

Published by MODERN PLASTICS, INC.
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Many essential products that formerly employed rubber can be served more efficiently and given longer life with VINYLITE Elastic Plastics. Flexible and stretchable like rubber, yet far superior to this vital material in many ways, VINYLITE Elastic Plastics are releasing rubber for those uses that it alone can serve.

VINYLITE Elastic Plastics are immune to many of the factors that cause rubber to deteriorate. They will not oxidize, and show no appreciable change even after prolonged aging. In abrasion resistance tests, certain types have proved superior to high-grade rubber compounds. Their tensile strength is higher than that of most rubber compounds. Under extreme climatic conditions, they do not become sticky or brittle —certain types retaining their flexibility even at –50 deg. F. Other types are non-flammable. Depending upon the formulation, unusual resistance to water, oils, and many corrosive chemicals can be obtained. Transparency is another unique feature impossible to obtain with rubber.

VINYLITE Elastic Plastics are available for war production needs in sheeting form and as compounds for molding, extrusion, and calendering. Sheeting is supplied in a wide range of transparent and opaque colors, in rolls of various widths and thicknesses. Compounds can be either injection or compression molded, extruded into continuous rods and tubes or into wire and cable coverings, or calendered directly onto cloth. For those industries which have the necessary processing equipment, such as the rubber industry, powdered VINYLITE Resins are available which can then be pigmented, blended with plasticizers, and formulated into flexible materials.

RUBBER-PROCESSING FACILITIES USABLE

Rubber manufacturers can realize important savings with VINYLITE Elastic Plastics. The handling of these materials is essentially the same as with rubber, and, with slight modifications, the same equipment can be used. However, no curing or vulcanizing is required, because VINYLITE Elastic Plastics come from the mold, extruding die, or calender mill as completed products.

If you are engaged in war production and seek flexible materials with the unusual resistance and durability of VINYLITE Elastic Plastics, we suggest that you enlist the full co-operation of our technical staff. Booklet P-5, "Vinylite Resins—Their Forms, Properties and Uses," describes these and other VINYLITE Plastics in detail.

Plastics Division

CARBIDE AND CARBON CHEMICALS CORPORATION

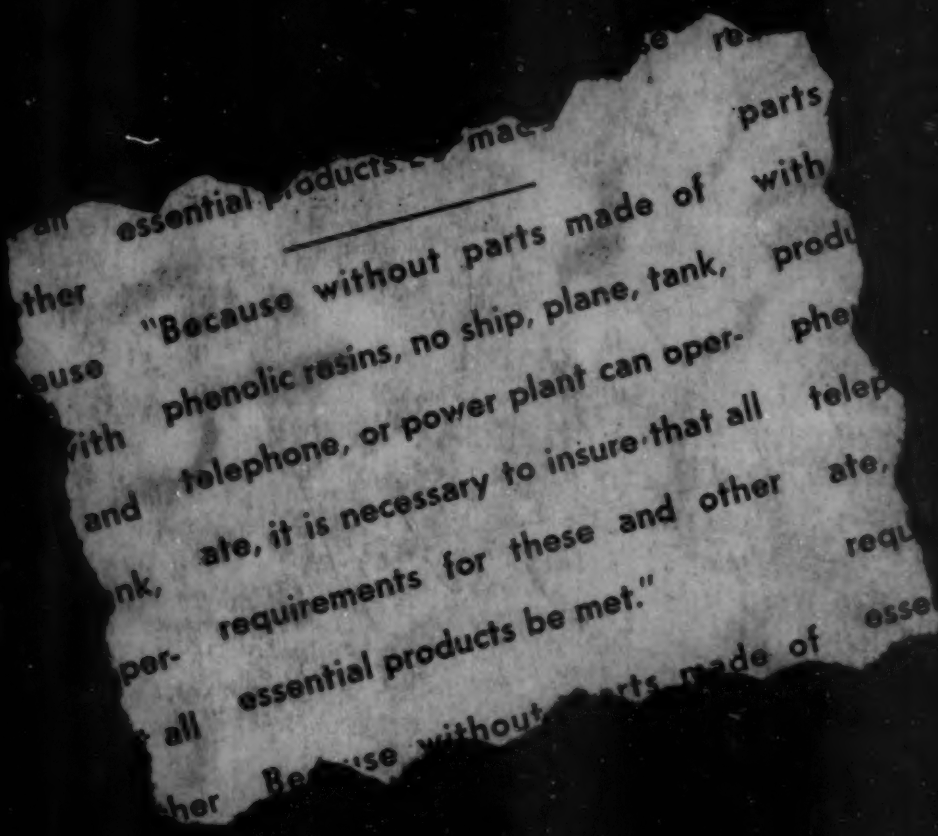
Unit of Union Carbide and Carbon Corporation

UCC

30 EAST 42ND STREET, NEW YORK, N.Y.

RIGID SHEETS · FLEXIBLE SHEETING AND FILM · ADHESIVES
MOLDING AND EXTRUSION COMPOUNDS · RESINS FOR SURFACE COATINGS

"No Ship, Plane, Tank, Telephone, Or Power Plant Can Operate......"


"Because without parts made of phenolic resins, no ship, plane, tank, telephone, or power plant can operate, it is necessary to insure that all requirements for these and other essential products be met."

That single sentence from an industry report on WPB's new order M-246 tells the story of plastics today, for in hundreds of new ways plastics are providing better weapons of war and improved tools for industrial production. The story of plastics tomorrow sketches even a wider horizon, where plastics will enter new fields and make products that are now only blueprints and imagination.

For complete information about the development, designing, engineering and manufacturing of plastics parts write Section A-1, One Plastics Avenue, Pittsfield, Mass.

PLASTICS DEPARTMENT

GENERAL ELECTRIC

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